

SCIENTIFIC CALCULATOR
CALCULADORA CIENTIFICA

CASIO *fx-3600P*

CASIO®

OPERATION MANUAL
MANUAL DE OPERACION

Dear customer,

Thank you very much for purchasing our scientific calculator.

This high-performance, pocket-size calculator employs true algebraic logic (judging the precedence of operations) and allows the use of up to 18 nesting parentheses at six levels. Its major features are 61 functions, seven memory registers, regression analysis, integrals, and up to 38 programmable steps for repeated calculation.

This booklet will familiarize you with the many ways this highly capable unit can serve you.

**Special care should be taken not to damage the unit by bending or dropping. For example, do not carry it in your hip pocket.*

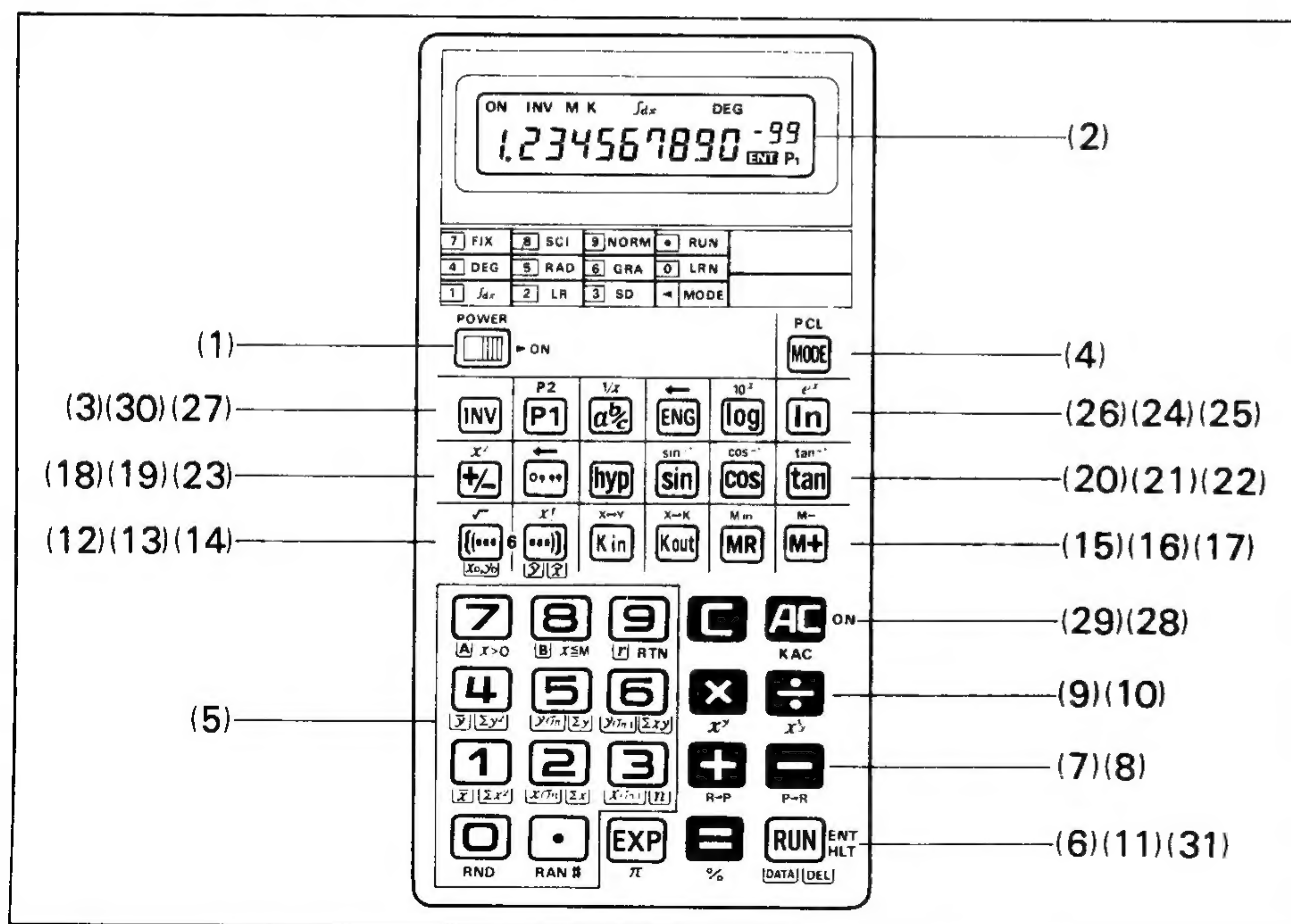
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■ Internal registers (user registers)

X-register (display)	}	<ul style="list-style-type: none"> • Used in arithmetic and functional calculations
Y (L1)-register		
L2-register		
L3-register		
L4-register		
L5-register		
L6-register	}	<ul style="list-style-type: none"> • Used in calculations with nesting parentheses and for judging the precedence of addition/subtraction and multiplication/division.
M-register		
K1 (Σx^2) register		
K2 (Σx) register		
K3 (n) register		
K4 (Σy^2) register		
K5 (Σy) register	}	<ul style="list-style-type: none"> • Independent memory register ($\boxed{M\downarrow}$, $\boxed{M+}$, $\boxed{M-}$, \boxed{MR})
K6 (Σxy) register		
		<ul style="list-style-type: none"> • Constant memory registers ($\boxed{K\text{in}}$, $\boxed{K\text{out}}$, $\boxed{1} - \boxed{6}$) • For storing intermediate results (Σx^2, Σx, n, etc.) of statistical calculations.

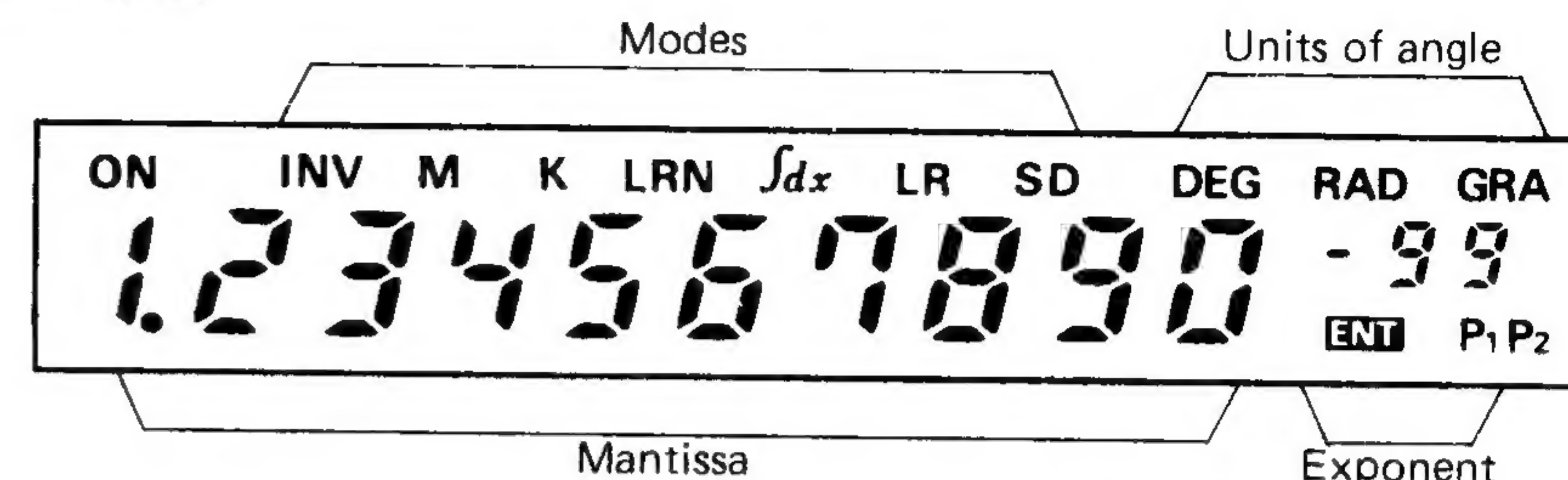
1 / NOMENCLATURE



(1) Power switch

Move the switch to the right to activate the calculator and "ON" is displayed. Even when power is off, the contents held in independent memory and constant memory registers, and the programs are not lost.

(2) Display




The display shows input data, intermediate results and results of operation. The mantissa section displays up to 10 digits (9 for negative numbers). The exponent section displays up to ± 99 .

The fraction and angle in the sexagesimal scale are displayed as follows:

456 $\frac{12}{23}$ is displayed 456┐12┐23.

12°34'56.7" is displayed 12°34'56.7



"E" (error check, see page 10) may be displayed in the position of the mantissa's least significant digit. "DEG", "RAD" or "GRA" (angular unit), "INV" (when the  key has been pressed), "M" (when data is stored in independent memory), "K" (during calculation with constants), "SD" (during calculation of standard deviation), "LR" (during calculation of regression analysis), and/or " $\int dx$ " (during execution of integral), as well as "LRN" and "ENT" will be displayed to indicate the operating mode.

Auto power-off

If the calculator is left with the power switch at the "ON" position (except while programmed calculation), the auto power-off function automatically turns off the power in approximately 6 minutes, thereby saving battery life. Power is resumed either by pressing the **AC** key or by re-operating the ON-OFF switch.





(Even when power is off, the contents of memories and written programs as well as the angular unit and operating mode are not lost.)

(3) **INV** Inverse key (symbolized by **INV**)

Activates the functions printed in brown on the keyboard.
When the  key is pressed, "INV" appears on the display and the subsequent pressing of  makes "INV" disappear.

(4) **MODE** Mode key (symbolized by **MODE**)

To put the calculator into the desired operating mode or select a specific angular unit, press **MODE** first, then **□**, **1**, , or **9**.

- **MODE**  : Manual and programmed calculations can be executed.
- **MODE**  : "LRN" is displayed. Programs can be written.
- **MODE**  : " $\int dx$ " is displayed. Integral can be carried out.
- **MODE**  : "LR" is displayed. Calculation of regression analysis can be executed.

- **MODE 3** : "SD" is displayed. Calculation of standard deviation can be executed.
- * To carry out manual or programmed calculation, select the RUN mode (press **MODE** and **0**).
- **MODE 4** : "DEG" is displayed, indicating that "degrees" is selected as the unit of angle.
- **MODE 5** : "RAD" is displayed, indicating that "radians" is selected as the unit of angle.
- **MODE 6** : "GRA" is displayed, indicating that "gradient" is selected as the unit of angle.

(Note: 90 degrees = $\pi/2$ radians = 100 gradients)

- **MODE 7** : "Fix" assignment (assignment for the number of fractional digits). Specify the number of digits of the fractional part after pressing **MODE** and **7**. (Example: **MODE 7 3** (three fractional digits are effective))
- **MODE 8** : "Scientific" assignment (assignment for the number of significant digits). Specify the number of significant digits after pressing **MODE** and **8**. (Example: **MODE 8 4**)
- **MODE 9** : "Normal" assignment. Press in this sequence to release the "fix" or "scientific" assignment.

* To clear programs, press this key, following the **INV** key. (**INV PCL** denotes this "program clear" sequence.)

* Once power is off, the "fix" and "scientific" assignments will be released but the operating mode ("LRN", " $\int dx$ ", "LR" or "SD") and the angular unit ("DEG", "RAD" or "GRA") will be kept.

(5) **0 - 9, . Numeral and decimal point keys**

Enters numerals. For decimal places, use the **.** key in its logical sequence.

* Varying functions will be designated when you press **INV** and a numeral key, as summarized below.

- **INV RND** : Cutting off internal data
The internal data (held in the Y-register) will be cut off so as to be equal to the displayed data.
- **INV RAN#** : Random number generation
A random number between 0.000 and 0.999 will be generated.

* Use following sequences in calculation of standard deviation and in regression analysis. For more details, refer to the chapter 6 "STATISTICAL CALCULATIONS".

- **INV \bar{x}** : Calculation of \bar{x} (average of x)
- **INV σ_n** : Calculation of σ_n (population standard deviation of x)
- **INV σ_{n-1}** : Calculation of σ_{n-1} (sample standard deviation of x)
- **INV \bar{y}** : Calculation of \bar{y} (average of y)
- **INV σ_n** : Calculation of σ_n (population standard deviation of y)
- **INV σ_{n-1}** : Calculation of σ_{n-1} (sample standard deviation of y)
- **INV A** : Calculation of A (constant terms in regression equations)
- **INV B** : Calculation of B (regression coefficients)
- **INV r** : Calculation of r (correlation coefficients)

* Different functions will be designated when you press **Kout**, then a numeral key as summarized below.

- **Kout Σx^2** : Calculation of Σx^2 (square sum of x)
- **Kout Σx** : Calculation of Σx (total sum of x)
- **Kout n** : Calculation of n (number of data)
- **Kout Σy^2** : Calculation of Σy^2 (square sum of y)
- **Kout Σy** : Calculation of Σy (total sum of y)
- **Kout Σxy** : Calculation of Σxy (inner product)

* Use **INV Σx^2** , **INV Σy^2** and **INV Σxy** only for writing programs (in "LRN" mode).

- **INV Σx^2** : Conditional jump
"Return to the first step of the program when the contents of the X-register (display) is positive and otherwise go to the next step."
- **INV Σy^2** : Conditional jump
"Return to the first step of the program when the contents of the X-register is equal to or smaller than those of the M-register (independent memory) and otherwise go to the next step."
- **INV Σxy** : Unconditional jump ("Return")
Press these keys to return to the first step of the program unconditionally.

(6) **EXP Pi entry key**

- Enters the exponent of ten up to ± 99 . To enter 2.34×10^{56} , for example, press **2 3 4 EXP 5 6** in sequence (symbolized by **EXP**).
- Enters circular constant in 10 digits (3.141592654) when pressed after **AC**, **C**, **CE**, **INV** or a function command key (symbolized by **π**).

(7) **+R-P Addition/Rectangular \rightarrow polar key**

- Enters summands.
- Performs rectangular to polar co-ordinates conversion when pressed after the **INV** key.

(8) **-P-R Subtraction/Polar \rightarrow rectangular key**

- Enters minuend.
- Performs polar to rectangular co-ordinates conversion when pressed after the **INV** key.

(9) **\times^y Multiplication/Power key**

- Enters multiplicand.
- Raises the base x to y th power when pressed after the **INV** key.

(10) **\div^y Division/Root key**

- Enters dividend.
- Calculates the y th root of x when pressed after the **INV** key.

(11) **\equiv Equal/Percent key**

- Obtains answer.
- Perform regular percentages, add-ons, discounts, ratios and increase/decrease values when pressed after the **INV** key.

(12) **$\{ \}$ Open parenthesis/Square root/Regression analysis data input key**

- Opens the parentheses. Nesting of up to 18 parentheses at six levels is allowed.
- Extracts the square root of the displayed number when pressed after the **INV** key. (In this manual this sequence is represented by **INV $\sqrt{\quad}$** . Other sequences described below are also represented in the same way.)
- Enters data (x) in regression analysis ("LR" mode).

(13) $\overline{)}\overline{)}$ Close parenthesis/Factorial/Regression analysis estimator key

- Closes the parentheses.
- Obtains the factorial of the displayed number when pressed after the $\overline{)}\overline{)}$ key.
- Obtains an estimator of regression in regression analysis ("LR" mode). \hat{y} will be obtained if you press it immediately after data entry and \hat{x} if you press it following $\overline{)}\overline{)}$ after data entry.

(14) $\overline{X \leftrightarrow Y}$ Constant memory entry/Register exchange key

- Enters numbers into each constant memory, through operation of ENTRY \overline{KIN} 1 (to 6).

Example: To enter 12.3 into constant memory 3.

12 \square 3 \overline{KIN} 3

- Exchanges the displayed number (X-register) with the content of the working register (Y-register) when pressed after the $\overline{)}\overline{)}$ key.

(15) $\overline{X \leftrightarrow K}$ Constant memory recall/Register exchange key

- Recalls the contents in each constant memory without clearing, through operation of \overline{KOUT} 1 (to 6).

Example: To recall the contents of constant memory 5.

\overline{KOUT} 5

- Exchanges the displayed number (X-register) with the contents of a constant memory (K-register) when pressed after the $\overline{)}\overline{)}$ key.

Example: To exchange the contents of constant memory 2 with the displayed number.

$\overline{)}\overline{)}$ $\overline{X \leftrightarrow K}$ 2

(16) \overline{MR} Independent memory recall/Independent memory entry key

- Recalls the contents of the independent memory (M-register) without clearing.
- Puts the displayed number in the independent memory when pressed after the $\overline{)}\overline{)}$ key. Old data held in the memory will be automatically erased.

(17) $\overline{M+}$ Memory plus (minus) key

- Adds the displayed number to the contents of the independent memory, and obtains answer in 4 basic calculations x^y/x^z and automatically adds it to the contents of the memory.
- Subtracts the displayed number from the contents of the independent memory, and obtains answer in 4 basic calculations x^y/x^z and automatically subtracts it from the contents of the memory when pressed after the $\overline{)}\overline{)}$ key.

(18) $\overline{+/-}$ Sign change/Square key

- Changes the sign of the displayed number from plus to minus and vice versa.
- Obtains the square of the displayed number when pressed after the $\overline{)}\overline{)}$ key.

(19) $\overline{D \leftrightarrow S}$ Sexagesimal/Decimal conversion key

- Converts the sexagesimal figure to decimal notation.
- Converts the decimal notation to sexagesimal notation when pressed after the $\overline{)}\overline{)}$ key.

(20) $\overline{\sin^{-1}}$ Sine/Arc sine key

- Obtains the sine of the displayed angle.
- Obtains the angle when pressed after the $\overline{)}\overline{)}$ key.

(21) $\overline{\cos^{-1}}$ Cosine/Arc cosine key

- Obtains the cosine of the displayed angle.
- Obtains the angle when pressed after the $\overline{)}\overline{)}$ key.

(22) $\overline{\tan^{-1}}$ Tangent/Arc tangent key

- Obtains the tangent of the displayed angle.
- Obtains the angle when pressed after the $\overline{)}\overline{)}$ key.

(23) \overline{hyp} Hyperbolic key

- Obtains the hyperbolic functions in combination with the $\overline{\sin}$, $\overline{\cos}$ or $\overline{\tan}$ key.
- Obtains the inverse hyperbolic functions in combination with the $\overline{\sin}$, $\overline{\cos}$ or $\overline{\tan}$ key when pressed after the $\overline{)}\overline{)}$ key.

(24) $\overline{10^x}$ Common logarithm/Antilogarithm key

- Obtains the common logarithm (base 10) of the displayed number.
- Calculates the xth power of 10 when pressed after the $\overline{)}\overline{)}$ key.

(25) $\overline{e^x}$ Natural logarithm/Exponential key

- Obtains the natural logarithm (base e) of the displayed number.
- Calculates the xth power of e (2.718281828) when pressed after the $\overline{)}\overline{)}$ key.

(26) \overline{ENG} Engineering key

Allows the displayed number to be shown with exponents of ten that are multiples of three (e.g., 10^3 , 10^6 , 10^9).

Ex.) 12 \square 3456

	12.3456
\overline{ENG}	12.3456 00
\overline{ENG}	12345.6 -03
\overline{ENG}	12345600. -06
\overline{ENG}	12345600. -06

12 \square 3456

	12.3456
\overline{INV} \overline{ENG}	0.0123456 03
\overline{INV} \overline{ENG}	0.000012345 06
\overline{INV} \overline{ENG}	0.000000012 09
\overline{INV} \overline{ENG}	0.000000012 09
\overline{ENG}	0.000012345 06
\overline{ENG}	0.0123456 03

(27) $\overline{1/x}$ Fraction entry/Reciprocal key

- Enters fractions for fraction calculations. To enter the fraction 1-2/3, for example, $\overline{1}$ $\overline{a/b}$ $\overline{2}$ $\overline{a/b}$ $\overline{3}$ in sequence.
- Obtains the reciprocal of the displayed number when pressed after the $\overline{)}\overline{)}$ key.

(28) $\overline{AC/ON}$ All clear key

- Clears the entire machine except the independent and constant memories, and also releases overflow or error check.
- Clears contents of all constant memories when pressed after the $\overline{)}\overline{)}$ key.
- It also overrides the auto power-off function.

(29) \overline{C} Clear key

Clears entry for correction.




(30) $\overline{P1}$ Program number key

This calculator is capable of holding two programs of up to 38 steps in total. P1 will be designated if you press this key and P2 if you press it after the $\overline{)}\overline{)}$ key. A sequence must be designated for executing a programmed calculation.







(31) RUN/ENT/HLT/Data entry/delete key

■ When a program is being written, depression of this key writes a halt instruction.

In the programmed operation mode, depression of this key restarts execution which has been temporarily suspended.

-  : When "LRN" is displayed (i.e. during program loading), depression of this key writes a halt instruction for data entry.
-  : When "LRN" is displayed, depression of this sequence writes a halt instruction for the display of a result.
-  : When execution is at a halt during programmed operation, depression of this key restarts execution.









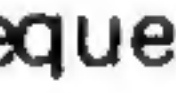

■ When "LR" or "SD" is displayed, this key works as a data entry/deletion key.

-  : In the SD mode, operate in the sequence of a data and .
In the LR mode, operate in the sequence of x data, , y data, and .
-  : To delete the data which has just been input, press this sequence instead of  in the above sequences.




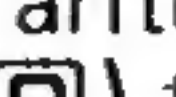
2/BATTERY MAINTENANCE

One lithium battery (Type: CR2025) gives approximately 1300 hours continuous operation.

When battery power decreases, the whole display darkens. Battery should then be renewed. Be sure to switch OFF the power before changing.

- 1) Side open the battery compartment lid on the back of the unit.
- 2) Remove dead battery and insert new battery with the plus terminal (flat side) on top.
- 3) Replace the battery compartment lid.
- 4) Press           in sequence.
 - * Before inserting the new battery, be sure to thoroughly wipe it off with a dry cloth to maintain good contacts.
 - * Never leave dead battery in the battery compartment.
 - * Remove the battery when not using for an extended period.
 - * It is recommended that battery be replaced every 2 years to prevent the chance of malfunctions due to battery leakage.
 - * Keep the batteries away from children. If swallowed consult your doctor immediately.

3/BEFORE USING THE CALCULATOR

Select the SD mode (press ) for standard deviation, the LR mode (press ) for regression analysis, the $\int dx$ mode () for carrying out integral, and the RUN mode () for ordinary arithmetic and functional calculations.

Select the LRN mode () to write a program.

Whatever angular unit is displayed does not matter in calculation which does not use angular data.

■ Precedence of operations and precedence levels















- This calculator automatically evaluates precedence of operations and executes in the proper sequence thus determined. The precedence of operations is as follows.


- ① Functions
- ② x^y , $x^{\frac{1}{y}}$
- ③ Multiplication and division
- ④ Addition and subtraction

Operations of the same precedence will be carried out in the order of input. An expression enclosed with a pair of parentheses will be given the highest precedence level.

- Internal registers L1 to L6 are used to retain intermediate results of operations, including expressions enclosed with parentheses, which have low precedence levels. Therefore, intermediate results of up to six levels may be retained.
- Up to three nested parentheses will be given the same precedence level. As a result, parentheses can be nested up to 18 pairs.
- * How to evaluate precedence levels (an example of 4 levels and 5 pairs of nested parentheses)






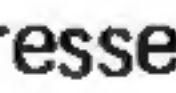


Expression: $2 \times \{ \{ (3 + 4 \times \{ (5 + 4) \div 3 \}) \div 5 \} + 9 \} =$

Entry operation:              
1 level 1 level 1 level 1 level

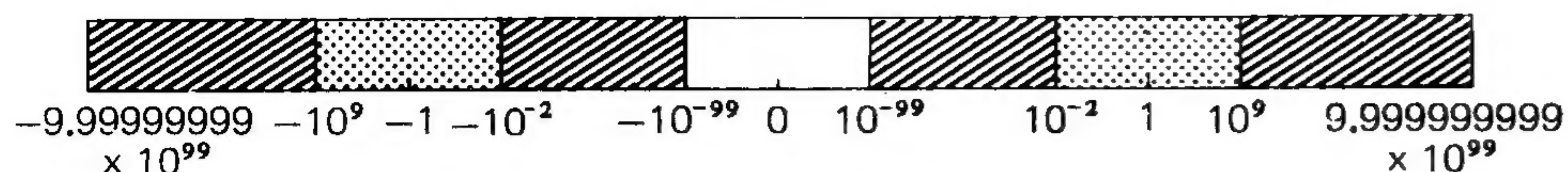
Contents of registers when entry has proceeded to 

X	4
L1	((5+
L2	4x
L3	((3+
L4	2x
L5	
L6	

■ Correction

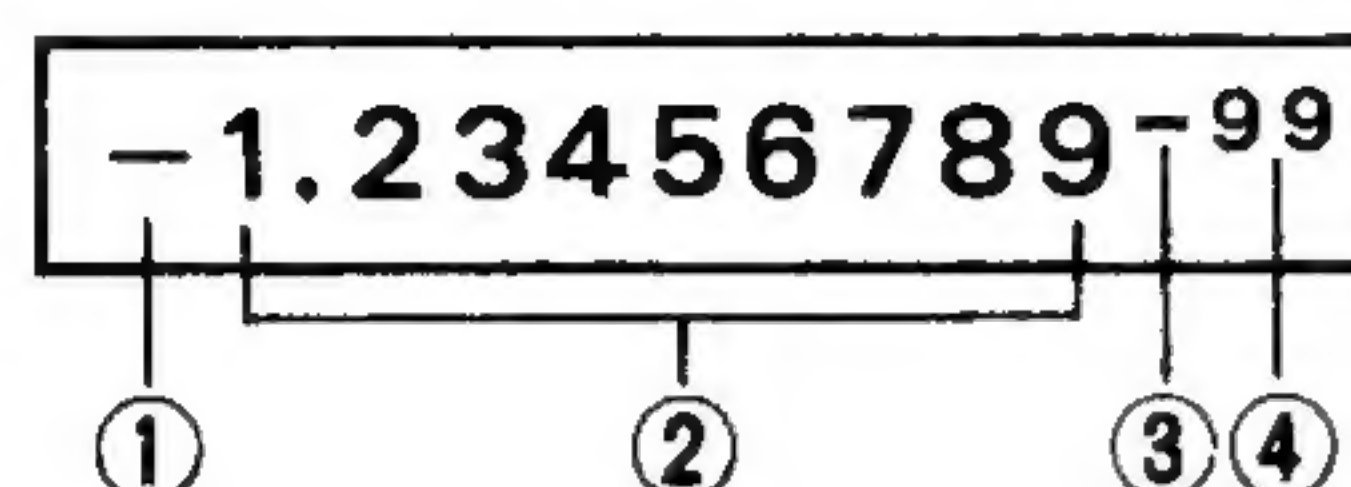
- If you are aware of data entry error before pressing a command key, press  and re-input the correct data.
- In a series of calculations, you can correct a wrong intermediate result of a functional calculation or within nested parentheses: press  and calculate the correct value, then resume the interrupted sequence of calculations.
- If you have pressed , , , ,  or  by mistake, you may press the correct key immediately. Note that, though the correct operation overrides the wrong one designated first, the precedence of operation of the first command remains effective.

■ Calculation range and scientific notation



Normal display
 Scientific notation

When the answer exceeds the normal display capacity, it is automatically shown by scientific notation, 10-digit mantissa and exponents of 10 up to ± 99 .



- ① The minus (—) sign for mantissa
- ② The mantissa
- ③ The minus (—) sign for exponent
- ④ The exponent of ten

The whole display is read: $-1.23456789 \times 10^{-99}$

* Entry can be made in scientific notation by using the EXP key after entering the mantissa.

EXAMPLE	OPERATION	READ-OUT
$-1.23456789 \times 10^{-3}$	$1 \square 23456789 \text{EXP}$	-1.23456789
$(=-0.00123456789)$	EXP	$-1.23456789 \text{ }^{00}$
	3EXP	$-1.23456789 \text{ }^{-03}$

■ Overflow or error check

Overflow or error is indicated by the "E." or "C." sign and stops further calculations.

Overflow or error occurs:

- When an answer, whether intermediate or final, or accumulated total in the independent memory is more than 1×10^{100} ("E." sign appears).
- When function calculations are performed with a number exceeding the input range ("E." sign appears).
- When unreasonable operations are performed in statistical calculations ("E." sign appears).
Ex.) You attempt to obtain \bar{x} or σ_n without any input data ($n = 0$).
- When the total number of levels of explicitly and/or implicitly (with addition-subtraction versus multiplication-division including x^y and $x^{\frac{1}{y}}$) nested parentheses exceeds six, or more than 18 pairs of parentheses are used.
Ex.) You have pressed the [] key 18 times continuously before designating the sequence of $2 \div 3 \times$.

To release these overflow checks:

- 1), 2), 3) Press the AC key.
- 4) Press the AC key. Or press the C key, and the intermediate result just before the overflow occurs is displayed and the subsequent calculation is possible.

4/NORMAL CALCULATIONS

* Set the function mode to "RUN" by pressing MODE \square .

* Calculations can be performed in the same sequence as the written formula (true algebraic logic).

* Nesting of up to 18 parentheses at six levels is allowed.

4-1 Four basic calculations

* Parenthesis calculations can not be performed with the function mode at "LR".

EXAMPLE	OPERATION	READ-OUT
$23+4.5-53=-25.5$	$23 \square + 4 \square . 5 \square - 53 \square =$	-25.5
$56 \times (-12) \div (-2.5) = 268.8$	$56 \square \times 12 \square \text{[]} \div 2 \square . 5 \square \text{[]} =$	268.8
$2 \div 3 \times (1 \times 10^{20}) = 6.666666667 \times 10^{19}$	$2 \square \div 3 \square \times 1 \square \text{EXP} 20 \square =$	$6.666666667 \text{ }^{19}$
$3 + 5 \times 6 (=3+30) = 33$	$3 \square + 5 \square \times 6 \square =$	$33.$
$7 \times 8 - 4 \times 5 (=56-20) = 36$	$7 \square \times 8 \square - 4 \square \times 5 \square =$	$36.$
$1+2-3 \times 4 \div 5+6=6.6$	$1 \square + 2 \square - 3 \square \times 4 \square \div 5 \square + 6 \square =$	6.6
$\frac{6}{4 \times 5} = 0.3$	$4 \square \times 5 \square \div 6 \square \text{[INV]} \text{[X-Y]} \square =$	0.3
$2 \times \{7+6 \times (5+4)\} = 122$	$2 \square \times \text{[]} 7 \square + 6 \square \times \text{[]} 5 \square + 4 \square \text{[]} =$	$\text{C01} \quad 0.$ $\text{C02} \quad 0.$ $122.$
$(2+3) \times 4 = 20$	$\text{[]} 2 \square + 3 \square \text{[]} \times 4 \square =$	$20.$
$\frac{3+4 \times 5}{5} = (3+4 \times 5) \div 5 = 4.6$	$\text{[]} 3 \square + 4 \square \times 5 \square \text{[]} \div 5 \square =$	4.6
$10 - \{7 \times (3+6)\} = -53$	$10 \square - \text{[]} 7 \square \times \text{[]} 3 \square + 6 \square \text{[]} =$	$-53.$

Another operation:

$$10 \square - \text{[]} 7 \square \times \text{[]} 3 \square + 6 \square \text{[]} =$$

4-2 Assignment for the number of fractional digits and the number of significant digits

- * To designate the number of fractional digits, press **MODE** **7** **n** in sequence.
To designate the number of significant digits, press **MODE** **8** **n**.
- * The "FIX" and/or "SCI" assignment will not be released until another assignment is made or **MODE** **9** is pressed. (Power-off and auto power-off release the assignments.)
- * Even when "FIX" and/or "SCI" is assigned, internal data use 11-digit mantissa. Press in the sequence **INV** **RND** to make the internal and displayed data equal.
- * Press **ENG** and the data will be converted to representation with the exponent of which is a multiple of three.

EXAMPLE	OPERATION	READ-OUT
100÷6=16.66666666.....	100 ÷ 6 =	16.66666667
(Specifies four fractional digits)	MODE 7 4	16.6667
(Releases assignment)	MODE 9	16.66666667
(Specifies five significant digits)	MODE 8 5	1.6667 ⁰¹
	MODE 9	16.66666667

* When an assignment for the number of digits is made, the data displayed is rounded up or down lowest digit position in the specified range but internal data remain unchanged in the registers. The assignment can be made at any time before or in the middle of calculation.

200÷7×14=400	MODE 7 3	0.000
	200 ÷ 7 =	28.571
(Continues calculation with internal data consisting of 11 digits.)	× 14 =	400.000

To perform the same calculation with internal rounding

	200 ÷ 7 =	28.571
(Internal rounding)	INV RND × 14 =	399.994
(Releases assignment)	MODE 9	399.994
123m × 456 = 56088m	123 × 456 =	56088.
= 56.088km	ENG	56.088 ⁰³
7.8g ÷ 96 = 0.08125g	7 ÷ 8 ÷ 96 =	0.08125
= 81.25mg	ENG	81.25 ⁻⁰³

4-3 Constant calculations

* The "K" sign appears when a number is set as a constant.

EXAMPLE	OPERATION	READ-OUT
3+2.3=5.3	2 □ 3 + + 3 =	K 5.3
6+2.3=8.3	6 =	K 8.3
7-5.6=1.4	5 □ 6 - = 7 =	K 1.4
-4.5-5.6=-10.1	4 □ 5 ± =	K -10.1
2.3×12=27.6	12 × × 2 □ 3 =	K 27.6
(-9)×12=-108	9 ± =	K -108.
74÷2.5=29.6	2 □ 5 ÷ ÷ 74 =	K 29.6
85.2÷2.5=34.08	85 □ 2 =	K 34.08
17+17+17+17=68	17 + + =	K 34.
	=	K 51.
	=	K 68.
1.7 ² =2.89	1 □ 7 × × =	K 2.89
1.7 ³ =4.913	=	K 4.913
1.7 ⁴ =8.3521	=	K 8.3521
3×6×4=72	3 × 6 × ×	K 18.
3×6×(-5)=-90	4 =	K 72.
	5 ± =	K -90.
$\frac{56}{4 \times (2+3)} = 2.8$	4 × (2 + 3) ÷ ÷	K 20.
	56 =	K 2.8
$\frac{23}{4 \times (2+3)} = 1.15$	23 =	K 1.15

4-4 Memory calculations using the independent memory

* When a new number is entered into the independent memory by the \boxed{M} key, the previous number stored is automatically cleared and the new number is put in the independent memory.

* The "M" sign appears when a number is stored in the independent memory.

* The contents accumulated into the independent memory are preserved even after the power switch is turned off.

To clear the contents press \boxed{C} \boxed{INV} \boxed{M} or \boxed{AC} \boxed{INV} \boxed{M} in sequence.

EXAMPLE	OPERATION	READ-OUT
$53+6= 59$	$53 \boxed{+} 6 \boxed{=}$ \boxed{INV} \boxed{M}	M 59.
$23-8= 15$	$23 \boxed{-} 8 \boxed{=}$ $\boxed{M+}$	M 15.
$56 \times 2 = 112$	$56 \boxed{\times} 2 \boxed{=}$ $\boxed{M+}$	M 112.
$\div) 99 \div 4 = 24.75$	$99 \boxed{\div} 4 \boxed{=}$ $\boxed{M+}$	M 24.75
	\boxed{MR}	M 210.75
$7+7-7+(2 \times 3) + (2 \times 3) + (2 \times 3) - (2 \times 3) = 19$	$7 \boxed{INV}$ \boxed{M} $\boxed{M+}$ \boxed{INV} $\boxed{M-}$ $2 \boxed{\times} 3 \boxed{M+}$ $\boxed{M+}$ $\boxed{M+}$ \boxed{INV} $\boxed{M-}$ \boxed{MR}	M 19.
$12 \times 3 = 36$	$3 \boxed{\times} 12 \boxed{=}$ \boxed{INV} \boxed{M}	M K 36.
$\rightarrow 45 \times 3 = 135$	$45 \boxed{INV}$ $\boxed{M-}$	M K 135.
$78 \times 3 = 234$	$78 \boxed{M+}$	M K 234.
	\boxed{MR}	M K 135.

4-5 Memory calculations using 6 constant memories

* When a new number is entered into a constant memory by operating ENTRY \boxed{KIN} (1 to 6), the previous number stored is automatically cleared and the new number is put in the constant memory.

* The contents stored in the constant memories are preserved even after the power switch is turned off.

To clear the contents press \boxed{C} \boxed{KIN} (1 to 6) or \boxed{AC} \boxed{KIN} (1 to 6) in sequence.

EXAMPLE	OPERATION	READ-OUT
$193.2 \div 23 = 8.4$	$193 \boxed{\div} 2 \boxed{KIN}$ (1) $\boxed{\div} 23 \boxed{=}$	8.4
$193.2 \div 28 = 6.9$	\boxed{KOUT} (1) $\boxed{\div} 28 \boxed{=}$	6.9
$193.2 \div 42 = 4.6$	\boxed{KOUT} (1) $\boxed{\div} 42 \boxed{=}$	4.6

* Another operations by using the independent memory:

$193 \boxed{\div} 2 \boxed{INV}$ \boxed{M} $\boxed{\div} 23 \boxed{=}$, \boxed{MR} $\boxed{\div} 28 \boxed{=}$, \boxed{MR} $\boxed{\div} 42 \boxed{=}$

EXAMPLE

$$\frac{9 \times 6 + 3}{(7-2) \times 8} = 1.425$$

OPERATION	READ-OUT
$9 \boxed{\times} 6 \boxed{+} 3 \boxed{=}$ \boxed{KIN} (1)	57.
$\boxed{7} \boxed{-} 2 \boxed{=}$ $\boxed{\times} 8 \boxed{=}$ \boxed{KIN} (2)	40.
\boxed{KOUT} (1) $\boxed{\div}$ \boxed{KOUT} (2) $\boxed{=}$	1.425

* Calculations in constant memory registers can also be performed by using the $\boxed{+}$, $\boxed{-}$, $\boxed{\times}$ and $\boxed{\div}$ keys.

$7 \boxed{KIN}$ (1) $\boxed{\times} 8 \boxed{KIN}$ (2) $\boxed{\times} 9 \boxed{KIN}$ (3) $\boxed{=}$ \boxed{INV} \boxed{MR}	M 504.
$4 \boxed{KIN}$ $\boxed{+}$ $\boxed{1} \boxed{\times} 5 \boxed{KIN}$ $\boxed{+}$ $\boxed{2} \boxed{\times} 6 \boxed{KIN}$ $\boxed{+}$ $\boxed{3} \boxed{=}$ \boxed{MR}	M 120.
$3 \boxed{KIN}$ $\boxed{+}$ $\boxed{1} \boxed{\times} 6 \boxed{KIN}$ $\boxed{+}$ $\boxed{2} \boxed{\times} 9 \boxed{KIN}$ $\boxed{+}$ $\boxed{3} \boxed{=}$ \boxed{MR}	M 162.
$7 \times 8 \times 9 = 504$	\boxed{KOUT} (1) M 14.
$4 \times 5 \times 6 = 120$	\boxed{KOUT} (2) M 19.
$3 \times 6 \times 9 = 162$	\boxed{KOUT} (3) M 24.
(Total) $14 \ 19 \ 24 \ 786$	\boxed{MR} M 786.

$$12 \times (2.3 + 3.4) - 5 = 63.4$$

$$30 \times (2.3 + 3.4 + 4.5) - 15 \times 4.5 = 238.5$$

$12 \boxed{\times} \boxed{2} \boxed{+} \boxed{3} \boxed{+} \boxed{3} \boxed{+} \boxed{4} \boxed{=}$ \boxed{KIN} (1) $\boxed{-} 5 \boxed{=}$	63.4
$30 \boxed{\times} 4 \boxed{+} 5 \boxed{KIN}$ (1) $\boxed{+}$ $\boxed{1} \boxed{INV}$ $\boxed{\times} \boxed{K}$ (1) $\boxed{-} 15 \boxed{\times} \boxed{KOUT}$ (1) $\boxed{=}$	238.5

To exchange the displayed number (4.5) with the contents of constant memory 1.

4-6 Fraction calculations

* The display capacity of a fraction, whether entry or result, is limited to a max. 3 digits for each integer, numerator or denominator part and at the same time to a max. 8 digits in the sum of each part. When an answer exceeds the above capacity, it is automatically converted to the decimal scale.

* A fraction can be transferred to the independent memory and the constant memories.

* A fraction answer can be converted to the decimal scale by pressing the $\boxed{\rightarrow}$ key. However, a decimal answer cannot be converted to the fraction scale.

EXAMPLE	OPERATION	READ-OUT
$4 \frac{5}{6} \times (3 \frac{1}{4} + 1 \frac{2}{3}) \div 7 \frac{8}{9} = 3 \frac{7}{568}$	$4 \boxed{\div} 5 \boxed{\div} 6 \boxed{\times} \boxed{3} \boxed{+} \boxed{1} \boxed{+} \boxed{4} \boxed{=}$ $1 \boxed{+} \boxed{2} \boxed{+} \boxed{3} \boxed{=}$ $7 \boxed{\div} 8 \boxed{\div} 9 \boxed{=}$	3 7 568.
(= 3.012323944)	$\boxed{\rightarrow}$	3.012323944

EXAMPLE	OPERATION	READ-OUT
$2\frac{4}{5} + \frac{3}{4} - 1\frac{1}{2} = 2\frac{1}{20}$	2 $\frac{4}{5}$ + $\frac{3}{4}$ - 1 $\frac{1}{2}$ =	3 11 20.
		3.55
	1 $\frac{1}{2}$ 1 $\frac{1}{2}$ 2 =	2 1 20.

$(1.5 \times 10^7) - \{(2.5 \times 10^6) \times \frac{3}{100}\}$ =14925000	1 5 EXP 7 - 2 5 EXP 6 \times 3 $\frac{3}{100}$ =	14925000.
---	--	-----------

* During a fraction calculation, a figure is reduced to the lowest terms by pressing a function command key ($\frac{1}{x}$, $\frac{1}{y}$, $\frac{1}{z}$ or $\frac{1}{w}$) or the $\frac{1}{x}$ key if the figure is reducible.

$3\frac{456}{78} = 8\frac{11}{13}$ (Reduction)	3 $\frac{456}{78}$ =	3 456 78.
		8 11 13.

$\frac{12}{45} - \frac{32}{56} = -\frac{32}{105}$	12 $\frac{32}{56}$ =	4 15.
	32 $\frac{32}{56}$ =	-32 105.

* The answer in a calculation performed between a fraction and a decimal is displayed as a decimal.

$\frac{41}{52} \times 78.9 = 62.20961538$	41 $\frac{52}{9}$ \times 78.9 =	41 52.
		62.20961538

4-7 Percentage calculations

EXAMPLE	OPERATION	READ-OUT
12% of 1500 180	1500 \times 12 INV %	180.
Percentage of 660 against 880 . . 75%	660 \div 880 INV %	75.
15% add-on of 2500 2875	2500 \times 15 INV % +	2875.
25% discount of 3500 2625	3500 \times 25 INV % -	2625.
300cc is added to a solution of 500cc. What is the percent of the new volume to the initial one?	300 + 500 INV %	160. (%)
If you made \$80 last week and \$100 this week, what is the percent increase?	100 - 80 INV %	25. (%)

EXAMPLE	OPERATION	READ-OUT
12% of 1200 144	1200 \times 12 INV %	K 144.
18% of 1200 216	18 INV %	K 216.
23% of 1200 276	23 INV %	K 276.
26% of 2200 572	26 \times 2200 INV %	K 572.
26% of 3300 858	3300 INV %	K 858.
26% of 3800 988	3800 INV %	K 988.
Percentage of 30 against 192 15.625%	192 \div 30 INV %	K 15.625
Percentage of 156 against 192 81.25%	156 INV %	K 81.25
600 grams was added to 1200 grams. What percent is the total to the initial weight? 150%	1200 + 600 INV %	K 150.
510 grams was added to 1200 grams. What percent is the total to the initial weight? 142.5%	510 INV %	K 142.5
How many percent down is 138 grams to 150 grams? down 8%	150 - 138 INV %	K -8.
How many percent down is 129 grams to 150 grams? down 14%	129 INV %	K -14.

5/FUNCTION CALCULATIONS

* Scientific function keys can be utilized as subroutines of four basic calculations (including parenthesis calculations).

* In some scientific functions, the display disappears momentarily while complicated formulas are being processed. So do not enter numerals or press a function key until the previous answer is displayed.

* For each input range of the scientific functions, refer to page 40.

5-1 Degree-Minute-Second \leftrightarrow Decimal conversion

The $\frac{1}{x}$ key converts the sexagesimal figure (degree, minute and second) to decimal notation. Operation of $\frac{1}{x}$ converts the decimal notation to the sexagesimal notation.

EXAMPLE	OPERATION	READ-OUT
$14^\circ 25' 36'' = 14.42666667^\circ$	14 $\frac{1}{x}$	14.
	25 $\frac{1}{x}$	14.41666667
	36 $\frac{1}{x}$	14.42666667
	INV $\frac{1}{x}$	14 25 36.

5-2 Trigonometric/Inverse trigonometric functions

EXAMPLE	OPERATION	READ-OUT
$\sin\left(\frac{\pi}{6}\text{rad}\right) = 0.5$	"RAD" (MODE 5) π \div 6 \sin	0.5
	"DEG"	
$\cos 63^\circ 52' 41'' = 0.440283084$	(MODE 4) 63 \div 52 \div 41 \cos	63.87805555 0.440283084
$\tan(-35\text{gra}) = -0.61280078$	"GRA" (MODE 6) 35 \tan	-0.61280078
$2 \cdot \sin 45^\circ \times \cos 65^\circ = 0.597672477$	"DEG" 2 \times 45 \sin \times 65 \cos	0.597672477
$\sin^{-1} \frac{1}{2} = 30^\circ$	"DEG" 1 \div 2 \sin^{-1}	30.
$\cos^{-1} \frac{\sqrt{2}}{2} = 0.785398163\text{rad}$	"RAD" 2 \sin^{-1} $\sqrt{\div}$ 2 \div 2 \cos^{-1}	0.785398163
$\tan^{-1} 0.6104 = 31.39989118^\circ$ $= 31^\circ 23' 59.61''$	"DEG" 0.6104 \tan^{-1}	31.39989118 31 $^\circ$ 23 $'$ 59.61 $''$
$\sin^{-1} 0.8 - \cos^{-1} 0.9 = 27^\circ 17' 17.41''$	"DEG" 0.8 \sin^{-1} \div 0.9 \cos^{-1}	27.28816959 27 $^\circ$ 17 $'$ 17.41 $''$

5-3 Hyperbolic/Inverse hyperbolic functions

EXAMPLE	OPERATION	READ-OUT
$\sinh 3.6 = 18.28545536$	3.6 \sinh	18.28545536
$\tanh 2.5 = 0.986614298$	2.5 \tanh	0.986614298
$\cosh 1.5 - \sinh 1.5 = 0.22313016$ $= e^{-1.5}$	1.5 \cosh \div 1.5 \sinh	2.352409615 0.22313016 -1.5
$\sinh^{-1} 30 = 4.094622224$	30 \sinh^{-1}	4.094622224
$\cosh^{-1}\left(\frac{20}{15}\right) = 0.795365461$	20 \div 15 \cosh^{-1}	0.795365461

EXAMPLE

Solve $\tanh 4x = 0.88$

$$x = \frac{\tanh^{-1} 0.88}{4} = 0.343941914$$

$$\sinh^{-1} 2 \times \cosh^{-1} 1.5 = 1.389388923$$

$$1.5 \times 2 = 3$$

5-4 Common & Natural logarithms/Exponentiations (Antilogarithms, Exponentials, Powers and Roots)

EXAMPLE	OPERATION	READ-OUT
$\log 1.23 (= \log_{10} 1.23) = 0.089905111$	1.23 \log	0.089905111
$\ln 90 (= \log_e 90) = 4.49980967$	90 \ln	4.49980967
$\log 456 \div \ln 456 = 0.434294481$	456 \log \div 456 \ln	0.434294481
$10^{1.23} = 16.98243652$	1.23 10^x	16.98243652
$e^{4.5} = 90.0171313$	4.5 e^x	90.0171313
$10^{0.4} + 5 \cdot e^{-3} = 2.760821773$	0.4 10^x $+$ 5 \times 3 e^{-x}	2.760821773
$5.6^{2.3} = 52.58143837$	5.6 x 2.3	52.58143837
$123^{\frac{1}{7}} (= \sqrt[7]{123}) = 1.988647795$	123 $\sqrt[x]{y}$ 7	1.988647795
$(78 - 23)^{-12} = 1.30511183 \times 10^{-21}$	78 \div 23 x 12 \div 12	1.30511183 $\times 10^{-21}$
$3^{12} + e^{10} = 553467.4658$	3 x 12 $+$ 10 e^x	553467.4658
$\log \sin 40^\circ + \log \cos 35^\circ = -0.27856798$	"DEG" (MODE 4) 40 \sin \log $+$ 35 \cos \log	-0.27856798 0.526540784
(The antilogarithm 0.526540784)		
$15^{\frac{1}{5}} + 25^{\frac{1}{6}} + 35^{\frac{1}{7}} = 5.090557037$	15 x 5 $+$ 25 x 6 $+$ 35 x 7	5.090557037

EXAMPLE	OPERATION	READ-OUT
* x^y and $x^{\frac{1}{y}}$ can be registered as a constant.		
$4^{2.5}=32$	2 \square 5 \square INV \square x^y \square INV \square x^y \square 4 \square =	K 32.
$0.16^{2.5}=0.01024$	\square 16 \square =	K 0.01024
$9^{2.5}=243$	9 \square =	K 243.

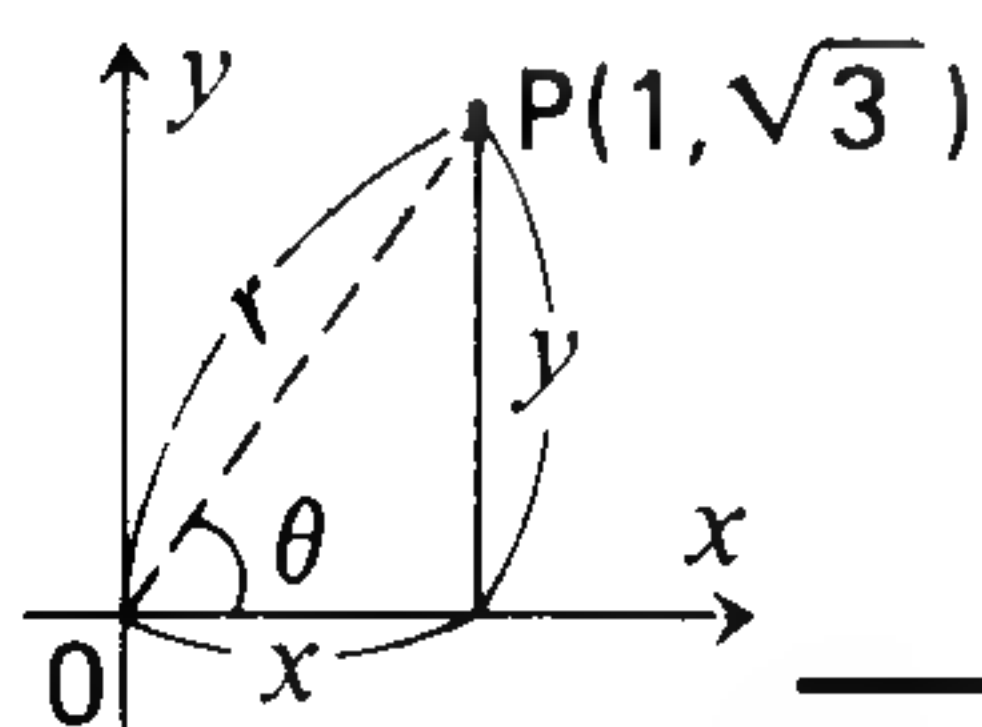
5-5 Square roots, Squares, Reciprocals, Factorials & Random numbers

EXAMPLE	OPERATION	READ-OUT
$\sqrt{2} + \sqrt{3} \times \sqrt{5} = 5.287196908$	2 \square INV \square $\sqrt{\square}$ \square + 3 \square INV \square $\sqrt{\square}$ \square \times 5 \square INV \square $\sqrt{\square}$ \square =	5.287196908
$123 + 30^2 = 1023$	123 \square + 30 \square INV \square x^2 \square =	1023.
$\frac{1}{\frac{1}{3} - \frac{1}{4}} = 12$	3 \square INV \square $\frac{1}{x}$ \square = 4 \square INV \square $\frac{1}{x}$ \square = INV \square $\frac{1}{x}$ \square =	12.
$8! (=1 \times 2 \times 3 \times \dots \times 7 \times 8) = 40320$	8 \square INV \square $x!$ \square =	40320.
Generate a random number between 0.000 and 0.999.	INV \square RAND \square =	0.570 (Example)

5-6 Rectangular to polar co-ordinates conversion

Formula: $r = \sqrt{x^2 + y^2}$
 $\theta = \tan^{-1} \frac{y}{x} \quad (-180^\circ < \theta \leq 180^\circ)$

Ex.)
 Find the length r and angle θ in radian when the point P is shown as $x = 1$ and $y = \sqrt{3}$ in the rectangular co-ordinates.



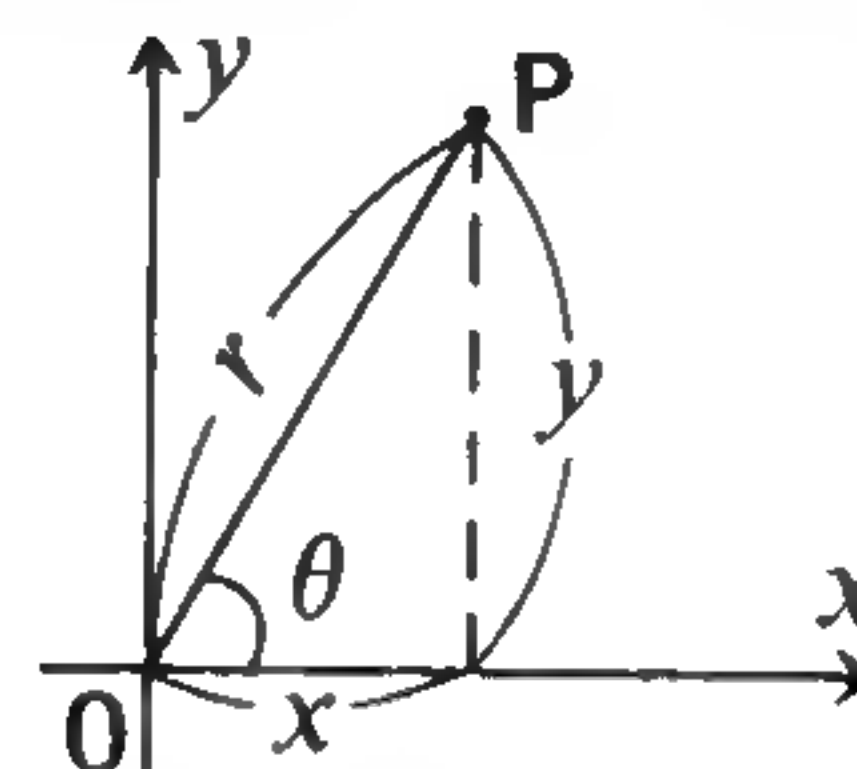
OPERATION	READ-OUT
"RAD" (MODE \square 5) 1 \square INV \square R \rightarrow P \square 3 \square INV \square $\sqrt{\square}$ \square =	2. (r)
INV \square $x \rightarrow y$ \square =	1.047197551 (θ in radian)

5-7 Polar to Rectangular co-ordinates conversion

Formula: $x = r \cdot \cos \theta$
 $y = r \cdot \sin \theta$

Ex.)

Obtain the values of x and y when the point P is shown as $\theta = 60^\circ$ and length $r = 2$ in the polar co-ordinates.



OPERATION	READ-OUT
"DEG" (MODE \square 4) 2 \square INV \square P \rightarrow R \square 60 \square =	1. (x)
INV \square $x \rightarrow y$ \square =	1.732050808 (y)

5-8 Applications

■ Decibel (dB) conversion

Ex.)

How many dB of amplifier gain is in an amp with 5mW of input power and 43W of output power?

Formula: $\text{dB} = 10 \cdot \log_{10} \frac{P_2}{P_1}$

P_1 : Input power (W)
 P_2 : Output power (W)

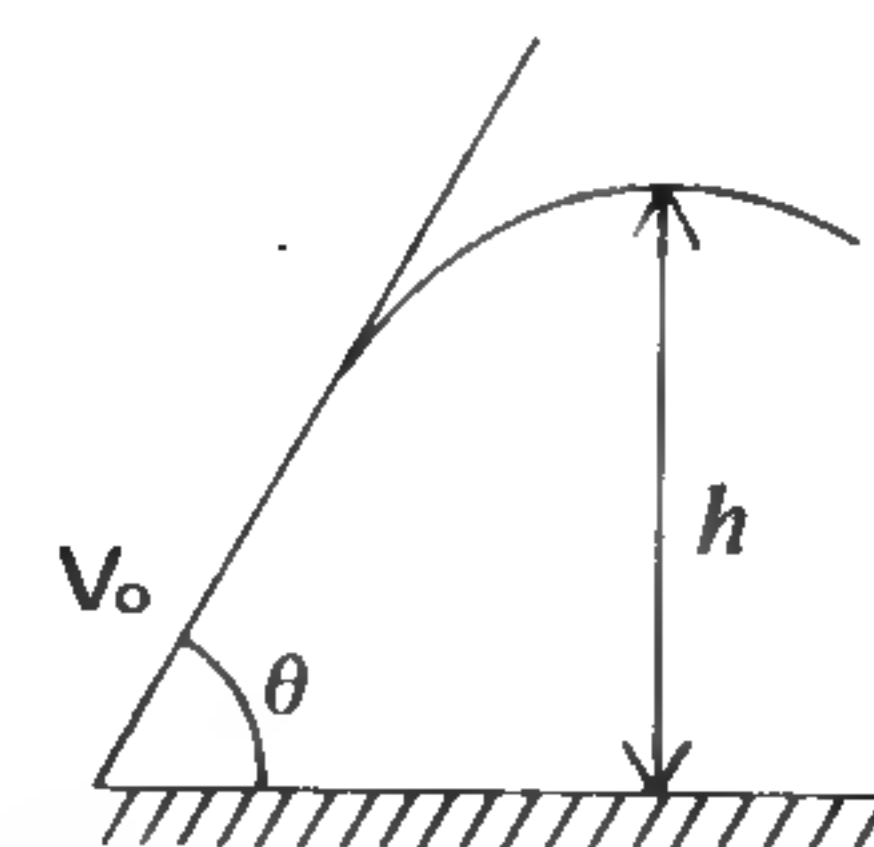
OPERATION	READ-OUT
10 \square \times (INV \square) 43 \square \div 5 \square EXP \square 3 \square \div \square (INV \square) \log \square =	39.34498451 (dB)

■ Parabolic movement

Ex.)

Obtain the height of a ball 3 seconds after throwing it at a 50° angle and at an initial velocity of 30 m/sec. (not calculating air resistance).

Formula: $h = V_0 t \sin \theta - \frac{1}{2} g t^2$

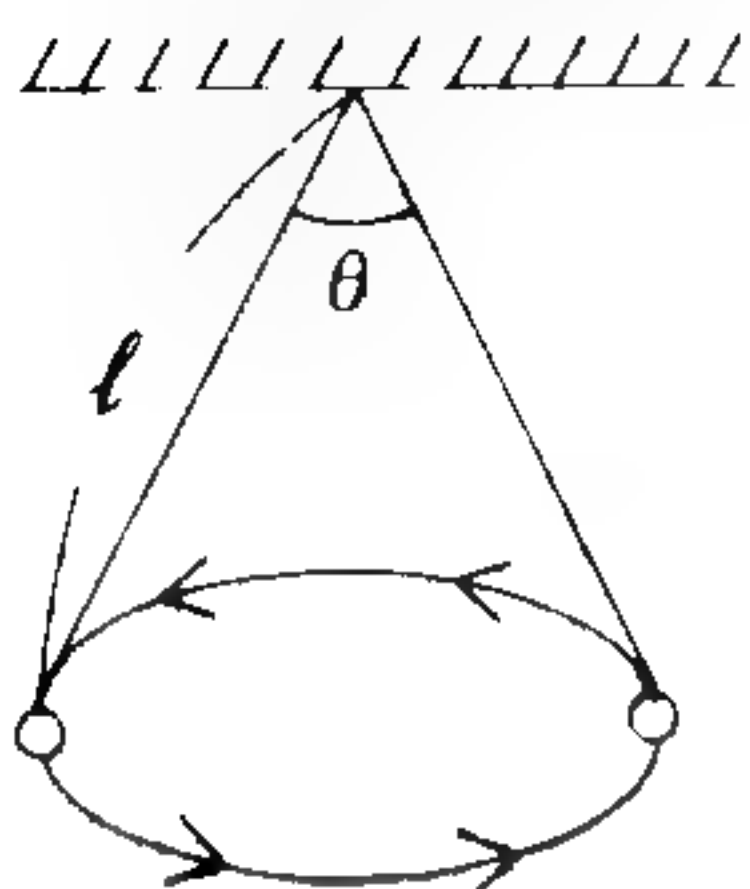


h : Height of ball at T seconds after thrown (m)
 V_0 : Initial velocity (m/sec.)
 t : Time (sec.)
 θ : Throwing angle to level surface
 g : Gravitational acceleration (9.8 m/sec.²)

OPERATION	READ-OUT
"DEG" (MODE \square 4) 30 \square \times 3 \square \times 50 \square SIN \square = 1 \square \div 2 \square \times 9 \square 8 \square \times 3 \square INV \square x^2 \square =	24.84399988 (m)

■ Cycle of a conical pendulum

Ex.) How many seconds is the cycle of a conical pendulum with a cord length of 30 cm and maximum swing angle of 90°?



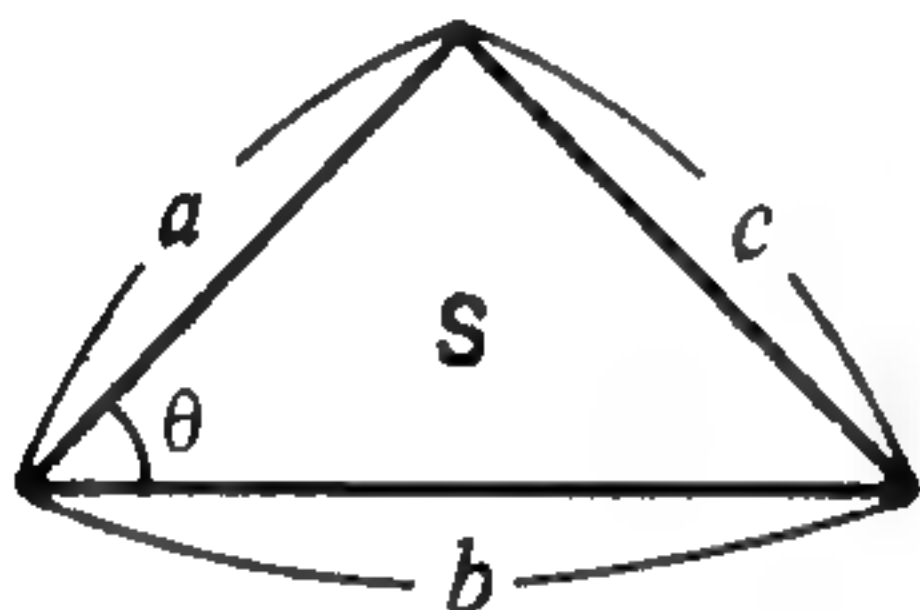
Formula: $T = 2\pi \cdot \sqrt{\frac{l \cdot \cos \frac{\theta}{2}}{g}}$

T : Cycle (sec.)
l : Cord length (m)
θ : Maximum cord swing angle
g : Gravitational acceleration (9.8 m/sec.²)

OPERATION	READ-OUT
"DEG" (MODE) 2 [x] [π] [x] [1/x] [0] 3 [x] [1/x] 90 [÷] 2 [1/x] [cos] [÷] 9 [0] 8 [1/x] [1/x] [1/x] [1/x]	0.924421332 (sec.)

■ Triangle

Ex.) Calculate the interior angle (θ) and area (S) of the triangle when the lengths of three sides (a, b and c) are given.



a: 18 m, b: 21 m, c: 12 m

Formula: $\cos \theta = \frac{a^2 + b^2 - c^2}{2ab}$

$S = \frac{1}{2}ab \cdot \sin \theta$

OPERATION	READ-OUT
"DEG" (MODE) 4) 18 [K in] 1 [1/x] [x ²] + 21 [K in] 2 [1/x] [x ²] - 12 [1/x] [x ²] = [÷] [1/x] [K out] 1 [x] [K out] 2 [x] [1/x] [Min] 2 [1/x] = [1/x] [cos] [1/x] [1/x] [sin] [x] [MR] [÷] 2 =	34°46'19. (θ) 107.7888561 (m ²)

■ Pro-rating

Division	Sales amount	%
A	\$ 84	22.4
B	153	40.8
C	138	36.8
Total	375	100.0

OPERATION	READ-OUT
[1/x] 84 + 153 + 138 [1/x] [÷] 100 [÷] [÷] 84 [1/x] [1/x] [MR] 153 [MR] 138 [MR] [MR]	375. M K 22.4 M K 40.8 M K 36.8 M K 100.

■ Time calculations

1 hr. 27 min. 58 sec.
1 hr. 35 min. 16 sec.
+) 1 hr. 41 min. 12 sec.
4 hr. 44 min. 26 sec.
Average: 1 hr. 34 min. 48.67 sec.

OPERATION	READ-OUT
1 [1/x] 27 [1/x] 58 [1/x] + 1 [1/x] 35 [1/x] 16 [1/x] + 1 [1/x] 41 [1/x] 12 [1/x] = [1/x] [1/x] [÷] 3 = [1/x] [1/x]	4°44'26. 1°34'48.67

6/STATISTICAL CALCULATIONS

* Be sure to press INV MODE in sequence prior to starting a statistical calculation.

6-1 Standard deviation

* Set the function mode to "SD" by pressing MODE MODE .

Ex.) Find σ_{n-1} , σ_n , \bar{x} , n , Σx and Σx^2 based on the data 55, 54, 51, 55, 53, 53, 54, 52.

OPERATION	READ-OUT
"SD" INV MODE MODE 55 DATA 54 DATA 51 DATA 55 DATA 53 DATA 53 DATA 54 DATA 52 DATA	52.
(Sample standard deviation) INV SD_{n-1}	1.407885953
(Population standard deviation) INV SD_n	1.316956719
(Arithmetic mean) INV \bar{x}	53.375
(Number of data) Kout n	8.
(Sum of value) Kout Σx	427.
(Sum of square value) Kout Σx^2	22805.

Calculate the unbiased variance and the deviation between each data item and the average.

(Subsequently) INV SD_{n-1} INV \bar{x}	1.982142857	(Unbiased variance)
INV \bar{x} 55 =	1.625	$(55 - \bar{x})$
54 =	0.625	$(54 - \bar{x})$
51 =	-2.375	$(51 - \bar{x})$
\vdots	\vdots	

Note: The sample standard deviation σ_{n-1} is defined as

$$\sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n - 1}}$$

the population standard deviation σ_n is defined as

$$\sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n}}$$

and the arithmetical mean \bar{x} is defined as $\frac{\Sigma x}{n}$

* Pressing SD_{n-1} , SD_n , \bar{x} , n , Σx , or Σx^2 key need not be done sequentially.

Ex.) Find n , \bar{x} & σ_{n-1} based on the data: 1.2, -0.9, -1.5, 2.7, -0.6, 0.5, 0.5, 0.5, 0.5, 1.3, 1.3, 1.3, 0.8, 0.8, 0.8, 0.8, 0.8.

OPERATION	READ-OUT
"SD" INV MODE 1 DATA 2 DATA 9 DATA	-0.9
① (Mistake) 2 DATA 5 DATA	-2.5
①' (To correct) C	0.
1 DATA 5 DATA	-1.5
2 DATA 7 DATA	2.7
② (Mistake) DATA	2.7
③ (Mistake) 1 DATA 6 DATA	-1.6
③' (To correct) INV DEL	-1.6
6 DATA	-0.6
②' (To correct) 2 DATA 7 INV DEL	2.7
5 DATA	0.5
4 DATA	0.5
④ (Mistake) 1 DATA 4 DATA	1.4
④' (To correct) AC	0.
1 DATA 3 DATA 3 DATA	1.3
8 DATA	0.8
⑤ (Mistake) 6 DATA	0.8
⑤' (To correct) 8 DATA 6 INV DEL	0.8
8 DATA 5 DATA	0.8
Kout n	17.
INV \bar{x}	0.635294117
INV SD_{n-1}	0.95390066

6-2 Regression analysis

* Set the function mode to "LR" by pressing **MODE** **2**.

■ Linear regression

Formula: $y = A + Bx$

$$B = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{n \cdot \Sigma x^2 - (\Sigma x)^2}$$

$$A = \frac{\Sigma y - B \cdot \Sigma x}{n}$$

$$r = \frac{n \cdot \Sigma xy - \Sigma x \cdot \Sigma y}{\sqrt{\{n \cdot \Sigma x^2 - (\Sigma x)^2\} \{n \cdot \Sigma y^2 - (\Sigma y)^2\}}}$$

Ex.) Results from measuring the length and temperature of a steel bar.

temp.	length
10°C	1003 mm
15	1005
20	1010
25	1008
30	1014

Find the constant term (A), regression coefficient (B), correlation coefficient (r) and estimated values (\hat{x} , \hat{y}) using the above figures as a basis.

OPERATION		READ-OUT
"LR"	INV 2ndF 10 2ndF	10.
	1003 DATA	1003.
	15 2ndF 1005 DATA	1005.
	20 2ndF 1010 DATA	1010.
	25 2ndF 1008 DATA	1008.
	30 2ndF 1014 DATA	1014.
	INV A	998. (A)
	INV B	0.5 (B)
	INV r	0.919018277 (r)
(When the temp. is 18°C)	18 2ndF	1007. (mm)
(When the length is 1000 mm)	1000 INV 2ndF	4. (°C)

Note: Σx^2 , Σx , n , Σy^2 , Σy , Σxy , \bar{x} , $x\sigma_n$, $x\sigma_{n-1}$, \bar{y} , $y\sigma_n$, $y\sigma_{n-1}$, A, B and r are respectively obtained by pressing a numeral key (1 to 9) after the **KEY** or **INV** key.

* Correction of data entry

Ex.)

x_i	2	3	2	3	2	4
y_i	3	4	4	5	5	5

OPERATION		READ-OUT
"LR"	INV 2ndF 2 2ndF 3 DATA	3.
① (Mistake)	4	4.
①' (To correct)	DEL	0.
	3 2ndF	3.
	4 DATA	4.
② (Mistake)	3 2ndF	3.
②' (To correct)	2 2ndF	2.
	4 DATA	4.
③ (Mistake)	1 2ndF	1.
	5 DATA	5.
③' (To correct)	INV DEL	5.
	3 2ndF 5 DATA	5.
	2 2ndF	2.
④ (Mistake)	4 DATA	4.
	4 2ndF	4.
⑤ (Mistake)	6 DATA	6.
⑤' (To correct)	INV DEL	6.
	4 2ndF 5 DATA	5.
④' (To correct)	2 2ndF 4 INV DEL	4.
	2 2ndF 5 DATA	5.

These ways of correction can also be applied to logarithmic, exponential or power regression.

■ Logarithmic regression

Formula: $y = A + B \cdot \ln x$

- * Input data items are the logarithm of x ($\ln x$), and y which is the same as in linear regression.
- * Operation for calculating and correcting regression coefficients are basically the same as in linear regression. Operate the sequence x \ln \square to obtain estimator \hat{y} and y \ln \square \ln \square for estimator \hat{x} . Note that $\Sigma \ln x$, $\Sigma (\ln x)^2$, and $\Sigma \ln x \cdot y$ are obtained instead of Σx , Σx^2 , and Σxy respectively.

Ex.)

x_i	29	50	74	103	118
y_i	1.6	23.5	38.0	46.4	48.9

Find A, B, r, \hat{x} and \hat{y} using the above figures as a basis.

OPERATION		READ-OUT
"LR"	\ln \square 29 \ln \square \square	3.36729583
	1 \square 6 \square DATA	1.6
	50 \ln \square 23 \square 5 \square DATA	23.5
	74 \ln \square 38 \square DATA	38.
	103 \ln \square 46 \square 4 \square DATA	46.4
	118 \ln \square 48 \square 9 \square DATA	48.9
	\ln \square A	-111.128397 (A)
	\ln \square B	34.02014743 (B)
	\ln \square r	0.994013945 (r)
(When x_i is 80)	80 \ln \square	37.94879479 (\hat{y})
(When y_i is 73)	73 \ln \square \ln \square	224.1541318 (\hat{x})

■ Exponential regression

Formula: $y = A \cdot e^{B \cdot x}$

- * Input data items are the logarithm of y ($\ln y$) and x which is the same as in linear regression.
- * Operation for correction is basically the same as in linear regression. Operate \ln \square A to obtain coefficient A, x \ln \square \ln \square for estimator \hat{y} , and y \ln \square \ln \square for estimator \hat{x} . Note that $\Sigma \ln y$, $\Sigma (\ln y)^2$, and $\Sigma x \cdot \ln y$ are obtained instead of Σy , Σy^2 , and Σxy .

Ex.)

x_i	6.9	12.9	19.8	26.7	35.1
y_i	21.4	15.7	12.1	8.5	5.2

Find A, B, r, \hat{x} and \hat{y} using the above figures as a basis.

OPERATION

READ-OUT

"LR"	\ln \square 6 \square 9 \square \square	6.9
	21 \square 4 \square DATA	3.063390922
	12 \square 9 \square 15 \square 7 \square DATA	2.753660712
	19 \square 8 \square 12 \square 1 \square DATA	2.493205453
	26 \square 7 \square 8 \square 5 \square DATA	2.140066164
	35 \square 1 \square 5 \square 2 \square DATA	1.648658626
	\ln \square A \ln \square \square	30.49758743 (A)
	\ln \square B	-0.0492037 (B)
	\ln \square r	-0.99724735 (r)
(When x_i is 16)	16 \ln \square \ln \square	13.87915739 (\hat{y})
(When y_i is 20)	20 \ln \square \ln \square	8.57486805 (\hat{x})

■ Power regression

Formula: $y = A \cdot x^B$

- * Input data items are $\ln x$ and $\ln y$.
- * Operation for correction is basically the same as in linear regression. Operate \ln \square A to obtain coefficient A, x \ln \square \ln \square for estimator \hat{y} , and y \ln \square \ln \square for estimator \hat{x} . Note that $\Sigma \ln x$, $\Sigma (\ln x)^2$, $\Sigma \ln y$, $\Sigma (\ln y)^2$, and $\Sigma \ln x \cdot \ln y$ are obtained instead of Σx , Σx^2 , Σy , Σy^2 , and Σxy respectively.

Ex.)

x_i	28	30	33	35	38
y_i	2410	3033	3895	4491	5717

Find A, B, r, \hat{x} and \hat{y} using the above figures as a basis.

OPERATION		READ-OUT
"LR"	\ln \square 28 \ln \square \square	3.33220451
	2410 \ln \square DATA	7.787382026
	30 \ln \square 3033 \ln \square DATA	8.017307508
	33 \ln \square 3895 \ln \square DATA	8.267448958
	35 \ln \square 4491 \ln \square DATA	8.409830673
	38 \ln \square 5717 \ln \square DATA	8.651199471
	\ln \square A \ln \square \square	0.238801299 (A)
	\ln \square B	2.771865947 (B)
	\ln \square r	0.998906243 (r)
(When x_i is 40)	40 \ln \square \ln \square	6587.67582 (\hat{y})
(When y_i is 1000)	1000 \ln \square \ln \square	20.26225439 (\hat{x})

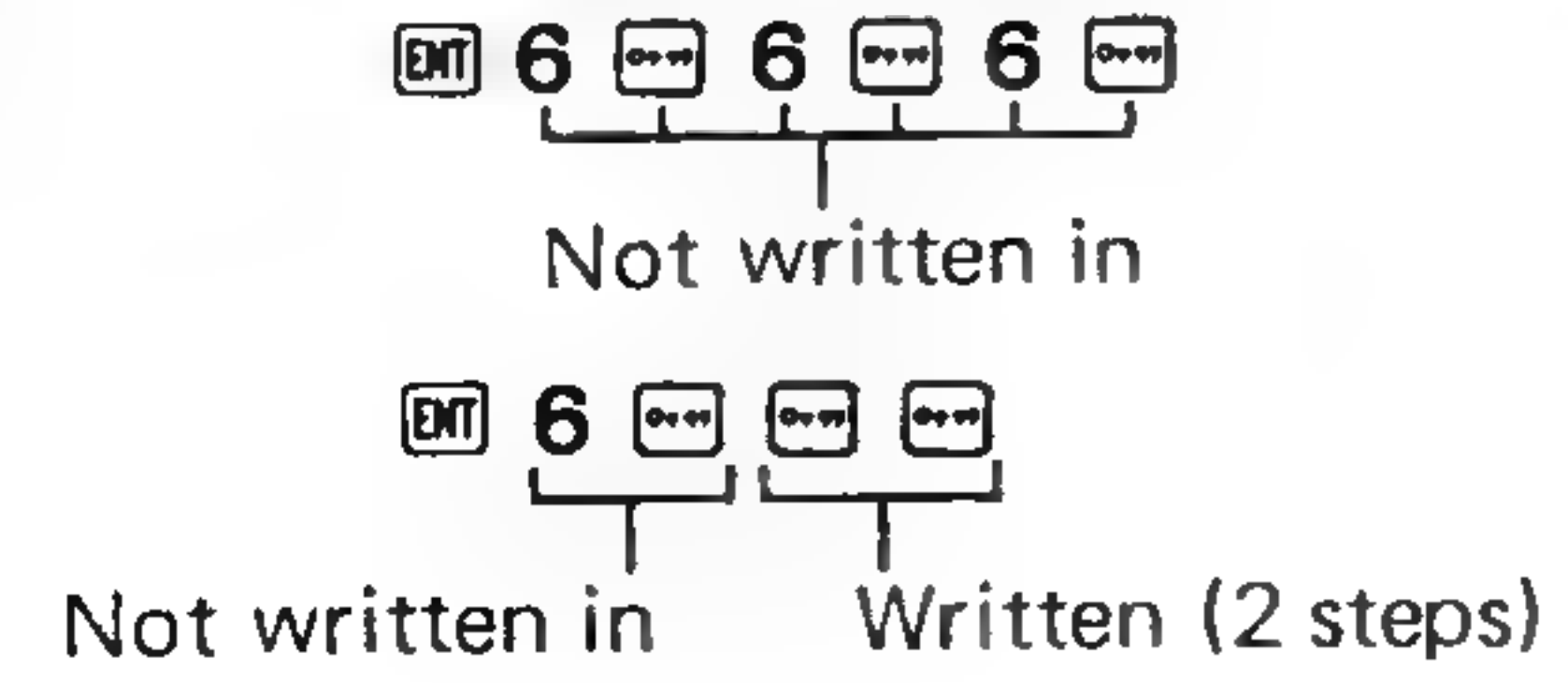
■ Program step

• The program is stored (written) in the calculator as shown below.

No. of steps	Program
1	P1 2
2	x
3	3
4	INV $\sqrt{}$
5	x
6	ENT
7	INV x^2
8	=
9	P2 MODE 4
10	ENT
11	Kin 1
12	x
13	ENT
14	Kin 2
15	x
16	π
17	\div
18	1
19	8
20	0
21	=
22	INV HLT
23	2
24	Kin x 1
25	Kin \div 2
26	Kout 2
27	sin
28	Kin x 1
29	Kout 1
30	
31	
⋮	⋮
36	*
37	
38	

- The program capacity is 38 steps. The program may be divided into two areas (P1 and P2) and each can be used independently of the other.
- An error results ("E" displayed) when there is an attempt to write the 39th step. No subsequent steps can be written. In this case, press **AC** to release the error check.
- After the program is started, instruction steps are executed one after another and execution does not stop. But it is needed to halt execution for inputting a data or reading a result. This is accomplished by **ENT** and **INV HLT**. When the end of a program is reached, execution stops automatically and the state is displayed. So, HLT may be absent.
- Each function comprises a step of program. The depression of keys in a certain sequence produces a single program step if it generates a single function.
 - 1) Functions generated by the depression of a single key
Ex.) Numeral value, +/−, +, −, x, \div , =, [(,)], sin, log, ENT,
 - 2) Functions generated by the depression of a two-key sequence
Ex.) INV x^2 , INV $\sqrt{}$, hyp sin, INV \sin^{-1} , INV $X \leftrightarrow Y$, INV x^y , INV $R \rightarrow P$, Kin 2, INV RAN#,
 - 3) Functions generated by the depression of a three-key sequence
Ex.) INV $X \leftrightarrow K$ 5, INV hyp \sin^{-1} , MODE 8 3 (Assignment for the number of significant digits), Kin x 3 (Multiplication with contents of K3 register),
- * If you have misoperated when writing a program (i.e. in the LRN mode), press the sequence of **INV PCL** and perform the correct operation.
- * The depression of a data entry key (**□**, **□** − **□**) followed by **EXP**, **$\frac{\square}{\square}$** , **$\frac{\square}{\square}$** , **$\frac{\square}{\square}$** or **$\frac{\square}{\square}$** will not be written in if such a sequence immediately follows the depression of **ENT**. Note that one of the functions which does not follow a numeric data will be written in as a step.

Example:



■ How to erase a program

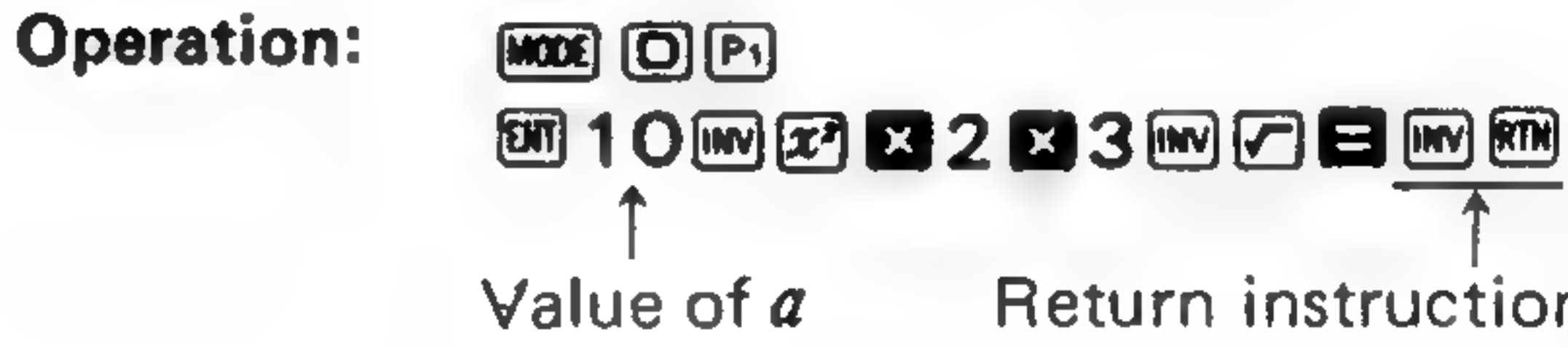
An old program will be automatically overwritten by a new program if the same program number is assigned to them.
To erase a program for making corrections or erase all 38 steps, operate the following sequence.

- To erase program P1 or P2:
MODE **□** **P1** (or **INV P2**) **INV PCL**
↑
Selects the LRN mode
- To erase both P1 and P2:
MODE **□** **INV PCL**

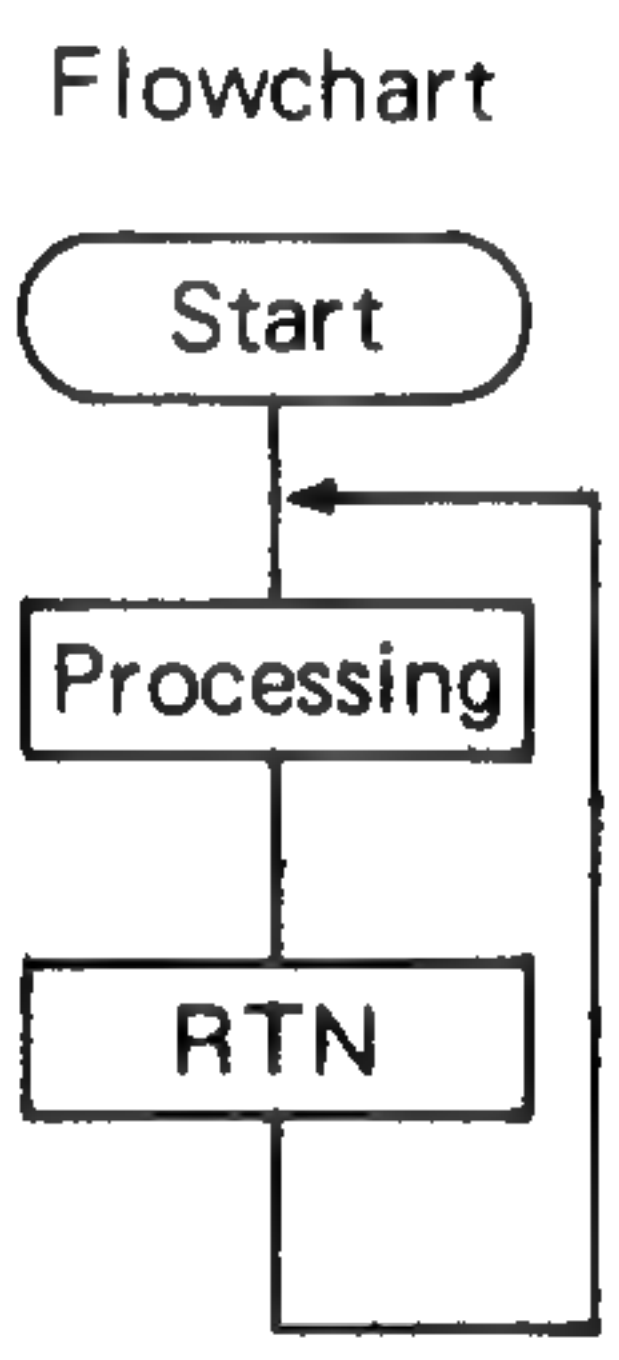
■ Jump instructions

There are two types of jump instructions as follows.

1. **Unconditional return to the first step of program: RTN**
Write the sequence of **INV RTN** at the end of a program to execute it repeatedly.
Example: Let us use the unconditional return instruction in the regular octahedron program explained on page 30. (In this case, the formula must be modified to $S = a^2 \times 2\sqrt{3}$.)



Step No.	Instruction step
1	ENT
2	INV x^2
3	x
4	2
5	x
6	3
7	INV $\sqrt{}$
8	=
9	INV RTN



OPERATION		READ-OUT	
(Select RUN mode)	MODE □	0.	
(Designate program No.)	P1	0. ENT P1	
(For $a = 7$)	7 RUN	169.7409791 ENT P1	Result S for $a = 7$
(For $a = 15$)	15 RUN	779.4228634 ENT P1	Result S for $a = 15$

* If a program includes an RTN instruction but neither ENT nor HLT, the program will, once started, not stop in an endless loop. To stop the program in such a case, press **AC**.

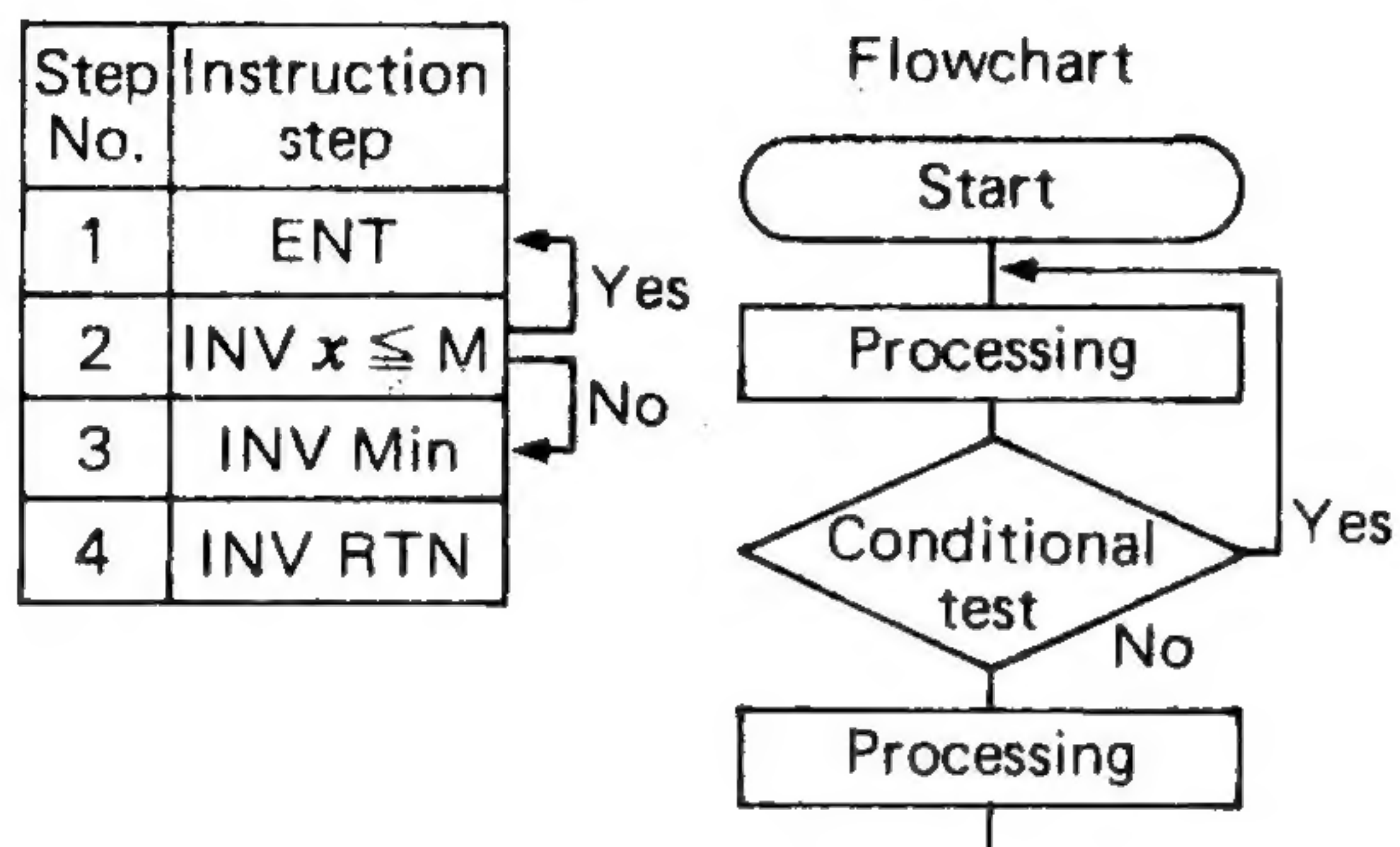
2. Return to the first step of program depending on the condition of the contents of the X-register (display):

$x > 0, x \leq M$

- $x > 0$: Return to the first step of program if the contents of the X-register is greater than zero and go to the next step otherwise.
- $x \leq M$: Return to the first step of program if the contents of the X-register is equal to or smaller than the contents of the M-register and otherwise go to the next step.

Example: Find the maximum of 456, 852, 321, 753, 369, 741, 684 and 643.

Operation: **MODE** **□** **INV** **P2**
ENT **INV** **X≤M** **INV** **Min** **INV** **RTN**



OPERATION READ-OUT

(Designate P2)	MODE □ ALC INV Min	0.	Memory cleared
	INV P2	0. ENT P2	
(Input data)	456 RUN	456. ENT P2	
	852 RUN	852. ENT P2	
	321 RUN	321. ENT P2	
	753 RUN	753. ENT P2	
	369 RUN	369. ENT P2	
	741 RUN	741. ENT P2	
	684 RUN	684. ENT P2	
	643 RUN	643. ENT P2	
	Min	852. ENT P2	Maximum displayed

■ Applications

• Permutation and combination

Calculate nPr and nCr for $(n = 10; r = 4)$ and $(n = 25; r = 5)$.

$$\left[nPr = \frac{n!}{(n-r)!}, nCr = \frac{n!}{r!(n-r)!} \right]$$

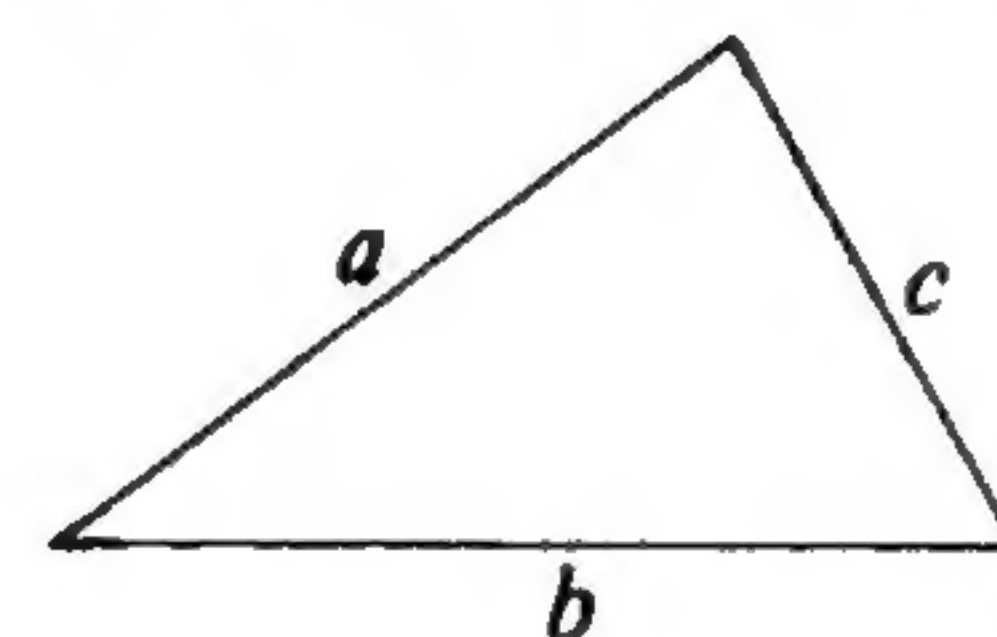
Programming:

MODE **□** **P1** **ENT** **10** **Kin** **1** **ENT** **4** **Kin** **2**
 "LRN" displayed (Value of n) (Value of r)
Kout **1** **INV** **X!** **÷** **(←)** **Kout** **1** **÷** **Kout** **2** **(→)** **INV** **X!** **=** 5040 (Permutation)
INV **P2** **ENT** **10** **Kin** **1** **ENT** **4** **Kin** **2**
 (Value of n) (Value of r)
Kout **1** **INV** **X!** **÷** **Kout** **2** **INV** **X!** **÷** **(←)** **Kout** **1** **÷** **Kout** **2** **(→)**
INV **X!** **=** 210 (Combination)

Operation:

MODE **□** **P1** **25** **RUN** **5** **RUN** 6375600 (Permutation)
INV **P2** **25** **RUN** **5** **RUN** 53130 (Combination)

• Calculate the area of a triangle when the lengths of the three sides are given.



$$\left[s = \frac{a+b+c}{2} \right. \\ \left. S = \sqrt{s(s-a)(s-b)(s-c)} \right]$$

How large is S when $a = 18$, $b = 22$ and $c = 31$?

How large is S when $a = 9.7$, $b = 13.4$ and $c = 6.5$?

Programming:

MODE **□** **P1** **ENT** **18** **Kin** **1** **+** **ENT** **22** **Kin** **2** **+** **ENT** **31** **Kin** **3**
 "LRN" displayed **=** **÷** **2** **=** **Kin** **4**
× **(←)** **Kout** **4** **÷** **Kout** **1** **(→)** **×** **(←)** **Kout** **4** **÷** **Kout** **2** **(→)**
× **(←)** **Kout** **4** **÷** **Kout** **3** **(→)** **=** **INV** **√** 194.2702692 (Area S)

Operation:

MODE **□** **P1** **9** **□** **7** **RUN** **13** **□** **4** **RUN** **6** **□** **5** **RUN** 29.61549594 (Area S)

• Sort sales slips by item code and add up the total of each item (for five items).

Code	Amount
3	2870
2	1960
5	3850
5	1250
1	2500
2	2310
3	1850
5	4370
3	5360
1	2220
2	1450
4	6120
1	3100



Code	Amount
1	7820
2	5720
3	10080
4	6120
5	9470

Programming:

MODE \square "LRN" displayed

(A) P1 ENT INV M_{in} ENT K_{in} 6 (A)

(B) K_{in} + 5 5 INV XSM (B)

(C) Kout 6 K_{in} - 5 K_{in} + 4 4 INV XSM (C)

(D) Kout 6 K_{in} - 4 K_{in} + 3 3 INV XSM (D)

(E) Kout 6 K_{in} - 3 K_{in} + 2 2 INV XSM (E)

(F) Kout 6 K_{in} - 2 K_{in} + 1 1 INV RTN (F)

(G) INV P₂ Kout 1 INV HLT Kout 2 INV HLT } (G)

Kout 3 INV HLT Kout 4 INV HLT Kout 5 }

- (A) Sets to input the code numbers into independent memory (M) and the amount to K the constant memory (K6).
- (B) Adds amount to K5 (still on display) temporarily and compares the code number (stored in M) with "5". If code number is 5, then amount is kept in K5 and returns to first line. If code number is less than 5, proceeds to the next line.
- (C) Subtracts the amount (stored in K6) from K5 and adds to K4 temporarily. Compares the code number with "4": if 4, then returns to first line, if less than 4 proceeds to next.
- (D), (E) Repeats same thing for code numbers 3 and 2.
- (F) Subtracts the amount (stored in K6) from K2 and adds to K1. Returns to first step.
- (G) Displays each amount accumulated per code number (contents of K1 through K5).

Operation:

MODE \square

INV \square P₁ 3 RUN 2870 RUN 2 RUN 1960 RUN 5 RUN 3850 RUN 5 RUN 1250 RUN
 1 RUN 2500 RUN 2 RUN 2310 RUN 3 RUN 1850 RUN 5 RUN 4370 RUN
 3 RUN 5360 RUN 1 RUN 2220 RUN 2 RUN 1450 RUN 4 RUN 6120 RUN
 1 RUN 3100 RUN

INV P₂ 7820 (Amount of code No. 1)
 RUN 5720 (Amount of code No. 2)
 RUN 10080 (Amount of code No. 3)
 RUN 6120 (Amount of code No. 4)
 RUN 9470 (Amount of code No. 5)

• Calculation for loan-repayment (Equally divided monthly repayment)

$$\text{Formula: } P = PV \frac{i}{1 - (1 + i)^{-n}}$$

P: Amount of monthly repayment
 PV: Amount of loan (Kin 1)
 i: Monthly interest (Kin 2)
 n: Number of times of repayment (Kin 3)

* The amount of repayment will be calculated in units of dollar by counting 50 cents or more as 1 dollar and disregarding the rest.

- 1) We borrow \$30,000 at an annual interest of 7.65% for 10 years. What is the amount of monthly repayment?
- 2) We borrow \$5,000 at an annual interest of 5.05% for 5 years. What is the amount of monthly repayment?

Programming:

MODE \square "LRN" displayed

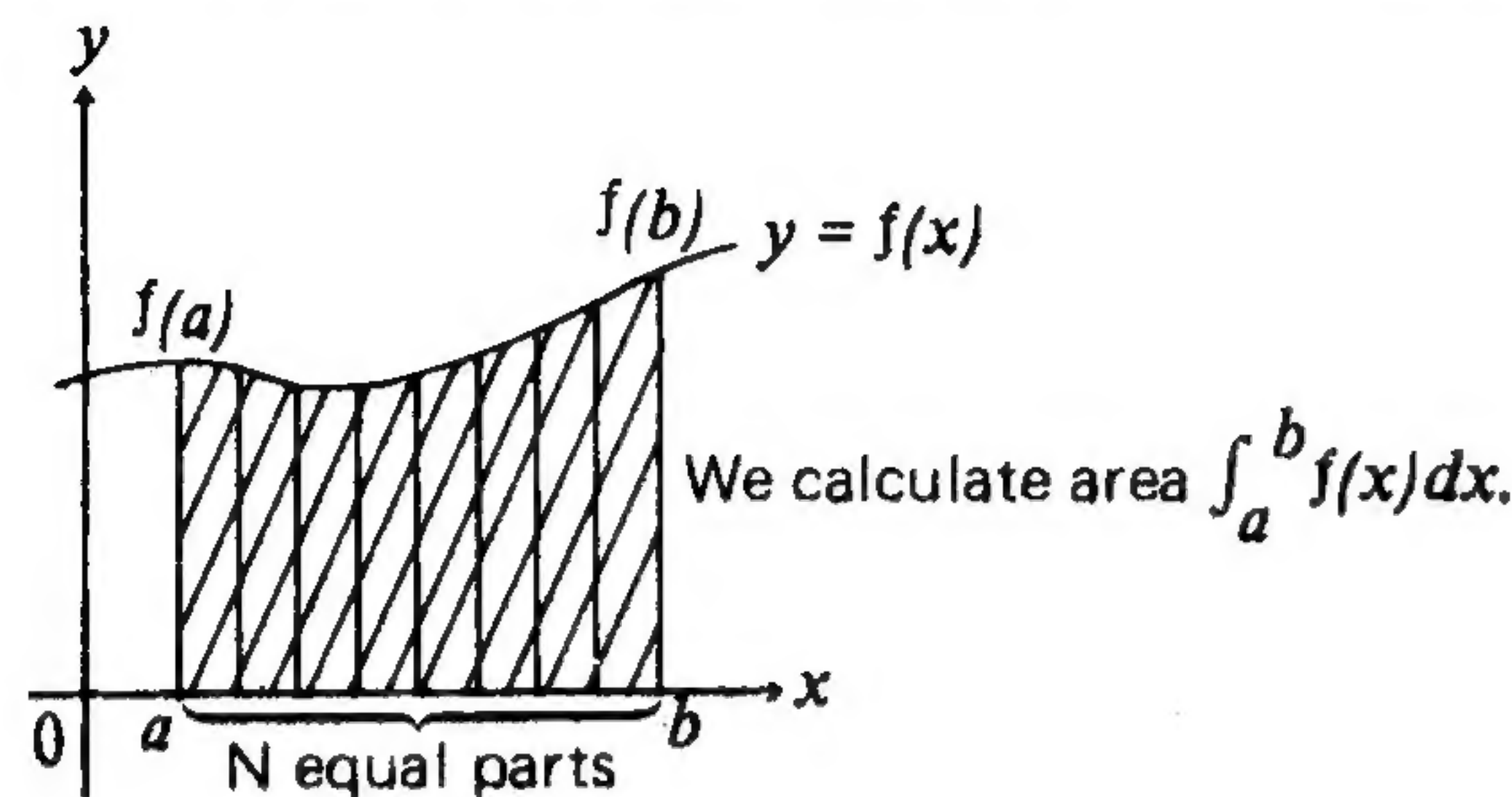
P₁ ENT 30000 K_{in} 1
 ENT 7 65 \div 12 EXP 2 = K_{in} 2
 ENT 10 \times 12 = K_{in} 3
 Kout 1 \times Kout 2 \div [(1 - [(1 + Kout 2)] INV \square Kout 3 \div \square)]
 = MODE \square 358 (Amount of monthly repayment)

Operation:

MODE \square P₁ 5000 RUN 5 05 RUN 5 RUN 94 (Amount of monthly repayment)

8/INTEGRALS

* To carry out integrals, ① define (write) function $f(x)$ during the "LRN" mode, then ② designate the interval of integral during the " $\int dx$ " mode.



* The approximation method used for integrating the function written in P1 or P2 is the Simpson's rule. This method requires to divide the interval of integral into equal parts. If the number of divisions is not specified, the calculator determines it by itself according to the form of the function. To specify it, designate n (an integer of 1 to 9) which meets $N = 2^n$ where N is the number of divisions.

■ Defining function $f(x)$

- 1) Select the "LRN" mode (press MODE 1).
- 2) Designate a program number (press P1 or INV P2).
- 3) Press INV MR .
* This is needed, as the first program step, to assign variable x of the function $f(x)$ to the M-register.
- 4) Write the expression of function $f(x)$ by true algebraic logic. Use MR to represent variable x . Write $=$ at the end.

Example: For $f(x) = \frac{1}{x^2 + 1}$, write the sequence of $1, \div, [(, \text{MR}, \text{INV } x^2, +, 1,)], =$.

- 5) Press MODE 1 to select the " $\int dx$ " mode.

Note: For a function $f(x)$ whose variable x cannot take the zero value, input an appropriate number in between steps 1) and 2) above.
Do not use constant registers, MC , CST and INT during expressing a function (step 4).

■ Execution of integral

- 1) Select the " $\int dx$ " mode (press MODE 1).
- 2) Designate the program number assigned to the function, $f(x)$. (Press P1 or INV P2 .)
- 3) Press a sequence of n INV RUN to specify division number N (this will be displayed). This step may be skipped.
- 4) Designate the interval of integral, $[a, b]$. (Press a RUN b RUN .)
- * In seconds or minutes the result will be displayed in a floating point representation.

At this time the memory registers contain the following data.

K1-register	(Press Kout 1) a
K2-register	(Press Kout 2) b
K3-register	(Press Kout 3) $N (= 2^n)$
K4-register	(Press Kout 4) $f(a)$
K5-register	(Press Kout 5) $f(b)$
K6-register	(Press Kout 6) $\int_a^b f(x)dx$
M-register	(Press MR) a

■ Example

For $f(x) = 2x^2 + 3x + 4$, calculate $\int_2^5 f(x)dx$ and $\int_2^8 f(x)dx$.

OPERATION	READ-OUT
(Select "LRN" mode) MODE 1	LRN 0. P1 P2
(Designate program No.) P1	LRN 0. P1
INV MR	LRN 0. P1
(Write $f(x)$) $2 \times \text{MR} \text{INV } x^2 + 3 \times \text{MR} + 4 =$	
(Select " $\int dx$ " mode) MODE 1	$\int dx$ 4.
(Designate program No.) P1	$\int dx$ 0. P1
(Input n) 2INV RUN	$\int dx$ 4. P1
(Input a and b) 2RUN 5RUN	1.215000000 0 2
(Designate program No.) P1	$\int dx$ 0. P1
(Input a and b) 2RUN 8RUN	4.500000000 0 2
Kout 1	$\int dx$ 2. a
Kout 2	$\int dx$ 8. b
Kout 3	$\int dx$ 8. N
Kout 4	$\int dx$ 18. $f(a)$
Kout 5	$\int dx$ 156. $f(b)$
Kout 6	$\int dx$ 450. $\int_a^b f(x)dx$

■ Remarks for execution of integrals

- * If you press **AC** during execution of integral (nothing is displayed), the execution will be aborted and the state selected by the depression of **MODE** **1** entered.
- * If no function $f(x)$ is defined (written in), the calculator will carry out integral for $f(x) = x$.
- * It is normal to set the angular mode to "RAD" when executing integral of trigonometrics.
- * Integral approximated by the Simpson's rule may take much execution time to raise the accuracy of result. Error may be large even when much execution time has been consumed. If the number of significant digits of result is smaller than one, error termination occurs ("E" displayed).
In such cases, dividing the integral interval will reduce execution time and raise accuracy:
 1. If the result varies greatly when the integral interval is moved slightly:
Divide the interval into sections and sum up the results obtained in the sections.
 2. For a periodic function or if the value of integral becomes positive or negative depending on the interval:
Calculate for each period or separately for the sections where the result of integral is positive from where the result is negative, and sum up the results obtained.
 3. If long execution time is due to the form of the function defined:
Divide the function, if possible, into terms, execute integral for each term separately, and sum up the results.

9/SPECIFICATIONS

■ Basic features

- **Basic operations:** 4 basic calculations, constants for $+/-/x/\div/x^y/x^{\frac{1}{y}}$, and parenthesis calculations.
- **Built-in functions:** trigonometric/inverse trigonometric functions (with angle in degrees, radians or gradients), hyperbolic/inverse hyperbolic functions, logarithmic/exponential functions, reciprocals, factorials, square roots, powers, roots, decimal \leftrightarrow sexagesimal conversion, conversion of co-ordinate system (R \rightarrow P, P \rightarrow R), random number, π , and percentages.
- **Statistical functions:** standard deviation, linear regression, logarithmic regression, exponential regression, and power regression.
- **Integrals:** Simpson's rule.
- **Memory:** 1 independent memory and 6 constant memories.
- **Capacity:**

	Input range	Output accuracy
Entry/basic functions:	10 digit mantissa, or 10 digit mantissa plus 2 digit exponent up to $10^{\pm 99}$.	
Fraction calculations:	Max. 3 digit mantissa for each integer, numerator or denominator and at the same time max. 8 digit mantissa for the sum of each part.	
Scientific functions:		
$\sin x / \cos x / \tan x$	$ x < 1440^\circ$ (8π rad, 1600 gra)	± 1 in the 10th digit
$\sin^{-1} x / \cos^{-1} x$	$ x \leq 1$	— " —
$\tan^{-1} x$	$ x < 1 \times 10^{100}$	— " —

$\sinh x / \cosh x / \tanh x$	$-227 \leq x \leq 230$	— " —
$\sinh^{-1} x$	$ x < 1 \times 10^{100}$	— " —
$\cosh^{-1} x$	$1 \leq x < 1 \times 10^{100}$	— " —
$\tanh^{-1} x$	$ x < 1$	— " —
$\log x / \ln x$	$0 < x < 1 \times 10^{100}$	— " —
e^x	$-227 \leq x \leq 230$	— " —
10^x	$ x < 100$	— " —
x^y	$ x < 1 \times 10^{100}$ $\begin{cases} x < 0 \rightarrow y : \text{integer} \\ x = 0 \rightarrow y > 0 \end{cases}$	— " —
$x^{\frac{1}{y}}$ ($\sqrt[y]{x}$)	$ x < 1 \times 10^{100}, y \neq 0$	— " —
\sqrt{x}	$0 \leq x < 1 \times 10^{100}$	— " —
x^2	$ x < 1 \times 10^{50}$	— " —
$1/x$	$ x < 1 \times 10^{100}, x \neq 0$	— " —
$x!$	$0 \leq x \leq 69$ (x : natural number)	— " —
POL \rightarrow REC	$ r < 1 \times 10^{100}$	— " —
	$ \theta < 1440^\circ$ (8π rad, 1600 gra)	
REC \rightarrow POL	$ x < 1 \times 10^{100}$	— " —
	$ y < 1 \times 10^{100}$	
o . . .	up to second	
π	10 digits	

■ Programmable features:

- **Total number of steps:** up to 38 (1 step performs a function).
- **Jump:** Unconditional jump (RTN), conditional jump ($x > 0, x \leq M$).
- **Number of programs storable:** up to 2 (P1 and P2).
- * Errors are cumulative with such internal continuous calculations as $x^y, x^{1/y}, x!$ so accuracy may be adversely affected.

■ Decimal point:

Full floating with underflow.

■ Read-out:

Liquid crystal display.

■ Power consumption:

0.00043 W

■ Power source:

One lithium battery (Type: CR2025).
The unit gives approximately 1300 hours continuous operation on type CR2025.

■ Ambient temperature range:

$0^\circ\text{C} - 40^\circ\text{C}$ ($32^\circ\text{F} - 104^\circ\text{F}$)

■ Dimensions:

8.7H x 71.5W x 134mmD ($3/8''$ H x $2-7/8''$ W x $5-1/4''$ D)

■ Weight:

64 g (2.3 oz) including battery.